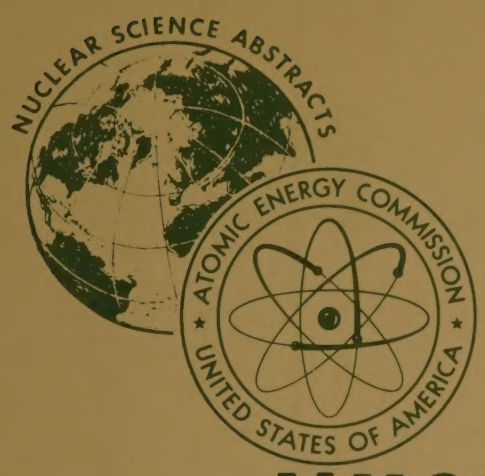

NUCLEAR SCIENCE ABSTRACTS

Volume 15 Number 19
Abstracts 24627–25733

October 15, 1961

UNITED STATES ATOMIC ENERGY COMMISSION
Division of Technical Information

USAEC DEPOSITORY LIBRARIES

Collections of USAEC reports are maintained in the libraries of the organizations listed below for reference use by the general public. Facilities for making photocopies are available. The USAEC also makes available through these libraries atomic energy reports of countries other than the U. S. that are abstracted in *Nuclear Science Abstracts*.

ALABAMA
Auburn, Auburn University
Birmingham, Public Library

ARIZONA
Tucson, University of Arizona

ARKANSAS
Fayetteville, University of Arkansas

CALIFORNIA
Berkeley, University of California
Los Angeles, University of California
Menlo Park, Stanford Research Institute
San Diego, Public Library

COLORADO
Denver, Public Library

CONNECTICUT
New Haven, Yale University

DELAWARE
Newark, University of Delaware

DISTRICT OF COLUMBIA
Washington, Library of Congress

FLORIDA
Coral Gables, University of Miami
Gainesville, University of Florida

GEORGIA
Atlanta, Georgia Institute of Technology

HAWAII
Honolulu, University of Hawaii

ILLINOIS
Chicago, John Crerar Library
Chicago, University of Chicago
Evanston, Northwestern University
Urbana, University of Illinois

INDIANA
Indianapolis, Public Library
Lafayette, Purdue University

IOWA
Ames, Iowa State University

KANSAS
Manhattan, Kansas State University

KENTUCKY
Lexington, University of Kentucky
Louisville, University of Louisville

LOUISIANA
Baton Rouge, Louisiana State University
New Orleans, Tulane University

MARYLAND
Baltimore, Johns Hopkins University
College Park, University of Maryland

MASSACHUSETTS
Cambridge, Harvard University
Cambridge, Massachusetts Institute of Technology

MICHIGAN
Ann Arbor, University of Michigan
Detroit, Public Library

MINNESOTA
Minneapolis, University of Minnesota

MISSOURI
Kansas City, Linda Hall Library
Rolla, University of Missouri School of Mines and Metallurgy
St. Louis, Washington University

MONTANA
Bozeman, Montana State College

NEVADA
Reno, University of Nevada

NEW JERSEY
Princeton, Princeton University

NEW MEXICO
Albuquerque, University of New Mexico

NEW YORK
Buffalo, University of Buffalo
Ithaca, Cornell University
New York, Atomic Industrial Forum, Inc.
New York, Columbia University
New York, Public Library
Rochester, University of Rochester
Schenectady, Union College
Syracuse, Syracuse University
Troy, Rensselaer Polytechnic Institute

NORTH CAROLINA
Charlotte, Charlotte and Mecklenburg County Public Library
Durham, Duke University
Raleigh, North Carolina State College

NORTH DAKOTA
Grand Forks, University of North Dakota

OHIO
Cincinnati, University of Cincinnati
Cleveland, Public Library
Columbus, Ohio State University
Toledo, University of Toledo
Youngstown, Youngstown University

OKLAHOMA
Stillwater, Oklahoma State University

OREGON
Corvallis, Oregon State College
Portland, Reed College

PENNSYLVANIA
Philadelphia, University of Pennsylvania
Pittsburgh, Carnegie Library
University Park, Pennsylvania State University

PUERTO RICO
Rio Piedras, University of Puerto Rico

RHODE ISLAND
Providence, Brown University

SOUTH CAROLINA
Columbia, University of South Carolina

TENNESSEE
Knoxville, University of Tennessee
Memphis, Public Library
Nashville, Joint University Libraries

TEXAS
Austin, University of Texas
College Station, Agricultural and Mechanical College of Texas
Dallas, Southern Methodist University
Houston, Rice Institute
San Antonio, Public Library

UTAH
Salt Lake City, University of Utah

VIRGINIA
Blacksburg, Virginia Polytechnic Institute
Charlottesville, University of Virginia

WASHINGTON
Pullman, Washington State University
Seattle, University of Washington

WEST VIRGINIA
Morgantown, West Virginia University

WISCONSIN
Madison, University of Wisconsin
Milwaukee, Public Library

WYOMING
Laramie, University of Wyoming

Volume 15, Number 19 October 15, 1961

NUCLEAR SCIENCE ABSTRACTS

A SEMIMONTHLY PUBLICATION OF THE DIVISION OF TECHNICAL INFORMATION, U. S. ATOMIC ENERGY COMMISSION

Nuclear Science Abstracts is the only comprehensive abstracting and indexing service devoted solely to the literature of nuclear science and technology. Published twice each month since 1947, *NSA* provides coverage of (1) technical reports of the United States Atomic Energy Commission and its contractors; (2) technical reports of government agencies, universities, and industrial and independent research organizations in the United States and abroad, and (3) the book, patent, and journal literature, and translations thereof, on a world-wide basis.

INDEXES

Regular Issues. Each issue of *NSA* includes subject, personal and corporate author, and report number indexes. Report numbers are also indicated in the author and subject indexes. The author indexes include "short titles" of the items indexed. The Report Number Index provides information on the availability of the reports.

Cumulations. The indexes included in the individual issues are cumulated quarterly, semiannually, and annually.* A cumulated report number, author, and subject index covering Vols. 1 through 4 (July 1948–1950) is included in the bound Vol. 4 which is available from the Johnson Reprint Corporation, 111 Fifth Ave., New York, N. Y. ($30.00). A subject and author index covering Vols. 5 through 10 (1951–1956) is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. ($5.25).

A cumulated report number index is issued annually as report TID-4000, *Public Availability of Reports Abstracted in Nuclear Science Abstracts*. This report is available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. ($5.00).

HOW TO OBTAIN NSA

Subscription. The semimonthly abstract issues and the four cumulated-index issues are available postpaid on subscription and in single copy from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at the prices indicated below:

- *Semimonthly issues.* Annual subscription rate: $22.00, domestic; $27.50, foreign. Price per single copy: $1.25, domestic; 25 per cent extra for foreign mailing.
- *Cumulated-index issues.* Annual subscription rate: $15.00, domestic; $17.50, foreign. Price per single copy varies according to the number of pages.*
- *Domestic subscription rates* apply to the United States, Canada, Mexico, and all Central and South American countries, except as noted below.
- *Foreign subscription rates* apply to Argentina, Brazil, British and French Guiana, Surinam, British Honduras, and all other countries throughout the world.

Exchange. *NSA* is also available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Division of Technical Information Extension, U. S. Atomic Energy Commission, P. O. Box 62, Oak Ridge, Tennessee.

Availability to Government Agencies. *NSA* is available free of charge to all U. S. Government Agencies upon request to the Division of Technical Information Extension, U. S. Atomic Energy Commission, P. O. Box 62, Oak Ridge, Tennessee.

*A five-year index cumulation for Volumes 11–15 will be issued early in 1962. Therefore, for the current Volume 15, there will be no annual index. A fourth-quarter index will be issued instead to complete the volume. The price of the Volume 11–15 index cumulation and information concerning the price adjustment for Volume 15 indexes will be announced later.

AVAILABILITY OF PUBLICATIONS ABSTRACTED

All U. S. Atomic Energy Commission reports are publicly available as indicated in the Report Number Index. Many reports of other government agencies and organizations, both in the United States and abroad, are publicly available. This information is included when known in the Report Number Index. Journal articles, books, and other published materials are available through standard commercial subscriptions or library sources.

Use of funds for printing this publication has been approved by the Bureau of the Budget, July 29, 1960.

TABLE OF CONTENTS

Volume 15, Number 19, October 15, 1961

Volume 15, Number 19 October 15, 1961

NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

24627 (DASA-1194) CRITICAL RADIANT EXPOSURES FOR PERSISTENT IGNITION OF CELLULOSIC TARGET COMPLEX MATERIALS. Lab. Project 5046-3, Part 124, Final Report. J. Bracciaventi and F. DeBold (Naval Material Lab., Brooklyn). July 7, 1960. 49p. (AD-249476)

Threshold radiant exposures for ignition of eight kindling materials were measured for simulated nuclear weapon pulses of thermal radiation. The effect of wind and moisture content on ignition was also measured. The distances for threshold ignition of six cellulosic kindling materials (black alpha cellulose, newsprint, fiberboard, cotton, and rayon) ranging in color from dark brown to black averaged 1.5 miles for a 50-kt burst, and 10.5 miles for a 10-Mt burst. For two materials, white and pale buff in color (white alpha cellulose and dry chest grass) the distances for threshold ignition averaged 0.9 miles for a 50-kt burst and 6 miles for a 10-Mt burst. Winds up to 10 mph caused differences in radiant exposures for ignition up to 50%, and conditioning at relative humidities from 20 to 100% changed ignition exposures by 70%. (auth)

24628 (HMI-B17) VIERTER JAHRESBERICHT (1960). (Fourth Annual Report (1960)). (Hahn-Meitner-Institut für Kernforschung, Berlin). May 1961. 102p.

A summary is given of the work of the nuclear chemistry and mathematics sections of the Hahn-Meitner Institut for the year 1960. The normal operation of the two sections is tabulated, and the special research work is indicated. The publications of the Institut are listed. (J.S.R.)

24629 (KR-7) QUARTERLY PROGRESS REPORT, JANUARY–FEBRUARY–MARCH, 1961. (Norway. Institutt for Atomenergi, Kjeller). June 1961. 89p.

A discussion is given of the activities of the Institutt for Atomenergi in reactor development, nuclear ship propulsion, neutron physics, fuel element development, fuel reprocessing, isotope production and use, safety work, The Netherlands-Norwegian Reactor School, and construction of buildings. The activities related to the OEEC Halden Reactor Project but performed at Kjeller are included. (B.O.G.)

24630 (NP-10447) MISSILES AND VENTURES INTO SPACE, 1960–1961 REPORT. Pamphlet No. 70-5-9. (Army. Washington, D. C.). June 1961. 81p.

Included are approximately 650 references, partly abstracted and annotated, selected from periodicals, books, and studies published during the period July, 1960 to April, 1961. (P.C.H.)

24631 (NYO-2575) APPLICATIONS OF ULTRASONIC ENERGY. TASK 1: ULTRASONIC CHEMICAL PROCESSING. TASK 2: ULTRASONIC METAL AND CERAMIC POWDER PROCESSING. TASK 3: ULTRASONIC INSTRUMENTATION. Progress Report No. 21, Covering Period April 1, 1960 to May 31, 1960. (Aeroprojects, Inc., West Chester, Penna.). June 1960. Contract AT(30-1)-1836. 32p.

Ultrasonic Chemical Processing: Pyrometallurgical reduction of U_3O_8 by molten magnesium in cadmium with ultrasonic excitation has effected greater than 99% reaction in four hours. Oxide-coated fissium pins were successfully fractured with low-power ultrasonic treatment at 1050 and 1200°C, consolidating the metal and yielding finely divided oxide flake. Ultrasonic Metal and Ceramic Powder Processing: A formulation of 38900 alumina containing 13.4 wt.% H_2O and 1 wt.% Superloid, which was too dry to be extruded, was extruded successfully with ultrasonic die activation. Ultrasonic extrusion of this composition represents more than two-fold reduction in the required amount of water. Simulated plate-type fuel elements, 0.060-in. thick and 24-in. deep, were successfully cast with standard ceramic formulations caused by the flow promotional effect of applied ultrasonic vibration. Ultrasonic mold activation resulted in the casting of slips with substantially increased solids content. Ultrasonic Instrumentation: Previous impedance measurements obtained by motional-loop, and elastic standing-wave-ratio methods for aqueous slurries of nickel and glass beads were confirmed. Experimental evidence showed that characteristics of various slurry concentrations can be determined in vessels of simple geometry without standing-wave variations influencing the results. (auth)

24632 (ORNL-3122) MOLTEN-SALT REACTOR PROGRAM PROGRESS REPORT FOR PERIOD FROM AUGUST 1, 1960, TO FEBRUARY 28, 1961. (Oak Ridge National Lab., Tenn.). June 27, 1961. Contract W-7405-eng-26. 161p.

Activities are discussed for work done on the design, components development, and engineering analysis of the MSRE, and materials development studies including metallurgy, in-pile tests, chemistry, engineering research, and fuel processing. (B.O.G.)

24633 (SRIA-11a) INSTRUCTOR'S GUIDE, SURVEY OF NUCLEAR ENERGY AND POWER PLANT APPLICATIONS. Howard M. Vollmer and Betty J. Maynard (Stanford Research Inst., Menlo Park, Calif.). Revised Edition, Sept. 1959. 85p.

An outline is given of a course of study for workers in atomic power plants designed to meet the need for an understanding of the nature of nuclear energy, its uses and

applications, its potential hazards, and structural and procedural safeguards used to protect against the hazards. The course is divided into sections on: principles of atomic structure; principles of radiation; radiation protection; energy from matter; nuclear reactors; nuclear fuels; reactor control and instrumentation; and the commercial development of nuclear energy. Training aids for the course and selective readings for the instructor and student are suggested. (B.O.G.)

24634 (TID-3043(Rev.1)(Suppl.2)) BIBLIOGRAPHIES OF INTEREST TO THE ATOMIC ENERGY PROGRAM. James M. Jacobs, Naomi K. Smelcer, and Hugh E. Voress, comps. (Office of Technical Information Extension, AEC). Jan. 1961. 69p.

Four hundred and forty two references to bibliographies and literature surveys on various aspects of atomic energy and allied subjects received during the period November 1959 to November 1960 are presented. References cited are to both report and published literature. They are arranged alphabetically by issuing agency. Subject, author, and report number availability indexes are provided. (auth)

24635 (TID-12102) NUCLEAR MATERIALS CONTROL IN POWER REACTOR OPERATIONS. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1961. Contract AT(45-1)-1350. 69p.

Presented are the basic principles and techniques which were found necessary for the establishment and maintenance of an adequate control system for nuclear materials used in power reactor operations in the United States. As an aid in the application of the principles, typical examples used or recommended for similar operations are presented. The nuclear and engineering technology related to nuclear materials accounting are discussed. A typical accounting system for maintaining suitable records and reports is given. Techniques used in providing assurance that the application of the system is effective are reviewed. (B.O.G.)

24636 (WT-1529) SUBSURFACE MOTION FROM A CONFINED UNDERGROUND DETONATION. PART I. William R. Perret (Sandia Corp., Albuquerque, N. Mex.). May 1961. Project 26.4b of Operation PLUMBBOB. 73p.

Supersedes ITR-1529.

Particle motion measurements were made within the mesa adjacent to Rainier shot on both a horizontal and a vertical radius. Principal information was derived from radial component acceleration data. Long-base strain gages on both radii provided some data of limited value. Horizontal radius data were obtained from 100 to 1355 feet from the source; vertical radius data were obtained from 366 feet to the surface at 896 feet. Most of the accelerometers were given set ranges below the actual peak accelerations produced by Rainier. A consequence of this was that many records required use of a nonlinear calibration procedure and a few included peaks truncated by saturation of the recording system. All acceleration data were integrated to particle velocity and displacement information. Peaks were added to truncated records to produce velocity-time data which implied return to zero velocity at a reasonable time after initial motion. Peak horizontal accelerations decay inversely as the fourth power of radial range to about 5g at 500 feet, then progressively as the inverse second and first powers. Peak vertical accelerations decrease as the inverse second power up to the base of the welded tuff (rhyolite) cap rock. Above that point peak accelerations increase, presumably as a result of reflection phenomena in a medium of decreasing seismic impedance as the surface is approached. Vertical acceleration and velocity data indicate development of at least three horizontal partings by a mechanism analogous to spalling and generation of a 1-second oscillation of a massive section of the mesa at least 530 feet thick above Rainier. This oscillation appears to be related to a 1-second surface wave which is propagated with a velocity of about 3000 feet per second outward to 3240 feet, as recorded by strong motion seismographs. Long-base strain gage data were limited on the horizontal radius by early mechanical failure caused by spalling of the tunnel walls. Strain gages in the vertical radius were limited to compressive strains by the method of mounting on steel cables. (auth)

24637 (ZPh-075) [PROGRESS REPORT OF] PROJECT DEFENDER. SCIENTIFIC REPORT NO. 4. (Convair, San Diego, Calif.). Dec. 31, 1960. Contract AF 19(604)-5554. 209p. (AD-252819)

A discussion is given of the work done in investigating the aspects of the launch-phase, and the experimental and theoretical mid-course phase of a ballistic missile. The work is intended to develop an understanding of the physical phenomena involved in these regions of missile trajectories. (B.O.G.)

24638 BRINGING IN ELECTRICAL PROPULSION. Richard J. Hayes (National Aeronautics and Space Administration, Washington, D. C.). Astronautics, 6: No. 7, 26-7, 103-7(July 1961).

Developments and feasibility of electrical propulsion systems are discussed. These developments deal primarily with experimental models, not with equipment that will put a man in space. The discussions are centered around power supplies, radiator components, and electric engines. Also discussed is beam neutralization elimination, power requirements, and application and performance. (N.W.R.)

24639 SPUTTERING AS A POSSIBLE MECHANISM FOR INCREASE OF IONIZATION IN THE VICINITY OF LOW-ALTITUDE SATELLITES. G. D. Magnuson and D. B. Medved (Convair, San Diego, Calif.). Planetary Space Sci., 5: 115-21(1961).

It is suggested that for altitudes below 200 km there may be sufficient sputtering produced by ion, atomic, and molecular impact on the vehicle surface to lead to some increase in ionization above ambient at distances of one mean path or less from the vehicle. The sputtering process injects into the environment atoms of metallic elements whose ionization potentials are $\frac{1}{2}$ to $\frac{1}{3}$ those of the ambient species. Collision energies in the center of mass system vary from ionization thresholds (E_i) to 2 to 3 times E_i. The resulting ionization in the surroundings may then be calculated if values for β, the probability of any collision leading to ionization, is known. On the basis of the crude model presented, β should be greater than or equal to 10^{-6} for this mechanism to be of interest. (auth)

24640 NUCLEAR ENGINEERING. Gilbert Cahen and Pierre Treille. Translated by Gilbert B. Melese. Boston, Allyn and Bacon, Inc., 1961. 404p.

Topics discussed include nuclear physics, reactor theory, reactor materials, reactor descriptions, radiation shielding, radiation equipment and measurements, industrial applications of reactors and radioisotopes, and reactor engineering techniques. There are radioisotope tables and other related data. (N.W.R.)

BIOLOGY AND MEDICINE

General and Miscellaneous

24641 (BNL-5451) A PHYSICIAN'S CONSIDERATION OF CRITERIA OF NUCLEAR REACTORS FOR MEDICAL THERAPY AND RESEARCH. Lee E. Farr (Brookhaven National Lab., Upton, N. Y.). 1961. 45p.

Presented at the International Symposium on Nuclear Medicine, Cologne, Germany, August 4-6, 1960.

Operational characteristics and design features of reactors for use in diagnosis and therapy are discussed. A brief description of the Brookhaven Medical Research Reactor and experimental facilities is included. Results are summarized from applications of neutron capture therapy following the administration of B^{10} in animal experiments and in the control of malignant intracranial neoplasms in man. The biological effects of neutrons and methods for neutron flux measurements are discussed. (C.H.)

24642 (TID-3077) RADIOISOTOPES IN MEDICINE AND HUMAN PHYSIOLOGY. A Selected List of References. J. A. McCormick (Office of Technical Information Extension, AEC). Mar. 1960. 127p.

This bibliography contains 2389 references on uses of radioisotopes in diagnostic medicine, therapeutic medicine, clinical research, human physiology, general medical research, and immunology. The references were taken from the 1957 to 1958 open literature. Author and isotope indexes, plus a list of the journals from which the references were selected, are included. (auth)

24643 (TID-13318) BIBLIOGRAPHY [ON] DIAGNOSTIC AND THERAPEUTIC USE OF RADIOISOTOPES IN THE CENTRAL NERVOUS SYSTEM OF MAMMALS. Marjorie Comstock (Brookhaven National Lab., Upton, N. Y.). July 12, 1961. 9p.

References (138) are given to Current List of Medical Literature, (CLML), Index Medicus (IM), Nuclear Science Abstracts (NSA), and journal items published since 1950. (P.C.H.)

24644 (UR-594) A UNIT FOR EXPOSURE OF ANIMALS TO RADIOACTIVE MERCURY VAPOR. Alastair D. Hayes and Aser Rothstein (Rochester, N. Y. Univ. Atomic Energy Project). May 5, 1961. Contract W-7401-eng-49. 17p.

In order to study the absorption, deposition, and excretion of inhaled mercury vapor in rats, a chamber was designed to utilize a mixture of stable mercury vapor and radiomercury vapor as a tracer for the exposure atmosphere. The design construction and operation of the chamber and its accessories are described in detail. Data pertinent to the operational characteristics of the chamber and accessories after a series of single and multiple dose exposures are also presented. (auth)

24645 (JPRS-9339) CYTOLOGY. Translation of Tsitologiya, Volume III, No. 1, 1961. 218p.

24646 (UCRL-Trans-693) LIGHT-INDUCED ESR (SIGNAL) IN CRYSTALLINE CHLOROPHYLL, IN THE PRESENCE OF WATER VAPOR. V. E. Kholmogorov and A. N. Terenin. Translated from Doklady Akad. Nauk S.S.S.R., 137: 199-202(1961). 9p.

The presence of dark and light ESR (electron spin resonance) signals in crystalline and amorphous chlorophyll was studied. The specimens were wrapped to permit evacuation of the ampoule before exposure to light. The kinetics of the build-up and loss of the light-induced ESR signals was recorded by establishing a magnitude for the magnetic field at which the ESR signal produced a maximum amplitude. Specimens of crystalline chlorophyll which were located in darkness, under vacuum conditions, at a temperature of 20°C, yielded an intense symmetrical absorption line. The intensity of the absorption corresponded to one unpaired electron to 10^3 molecules of chlorophyll. The signal increment, which was produced by illumination, reversibly disappeared in darkness in the course of several hours. The illumination of the specimens in air produced a new, narrower symmetrical line of absorption. The effects of water vapor on the appearance of the ESR signal were determined. (M.C.G.)

24647 THE ACTION OF ANTERIOR PITUITARY TRANSPLANTS ON THE WEIGHT AND THE FUNCTION OF ADRENAL GLANDS OF HYPOPHYSECTOMIZED RATS. Petar N. Martinovitch, Z. M. Bacq, Desanka Pavić, and Djurdjina Simić-Sladić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 199-207(Mar. 1961). (In English)

The influence of anterior pituitary transplants grafted in heterotopic positions on the weight and the functional activity of adrenal glands of hypophysectomized rats was studied. It was found that the grafted anterior pituitaries could indefinitely, and to a considerable degree, maintain or influence partial recovery of the weight of the adrenal glands. When exposed to a lethal dose of x rays the adrenal glands of thus treated rats showed a significant fall in cholesterol. Upon the removal of grafts the weight of the adrenal glands fell back to that of hypophysectomized controls, and the cholesterol reaction failed to take place. (auth)

24648 THE EFFECT OF THE CULTIVATION PERIOD AND COMPOSITION OF THE NUTRIENT MEDIUM ON THE PRODUCTS OF $C^{14}O_2$ ASSIMILATION BY HYDROGEN OXIDIZING BACTERIA. A. K. Romanova, N. G. Doman, and Z. A. Terent'eva (Bakh Inst. of Biochemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 231-4(May 1, 1961). (In Russian)

A 3-day, 7-day, and 14-day culture, which were fed in a liquid nutrient of minerals through which a gas containing 60% H_2, 15% CO_2, and 25% air was passed, were exposed for 5, 15, and 30 seconds to an atmosphere containing 15% $C^{14}O_2$, 60% H_2, and 25% air. The $C^{14}O_2$ fixation products were chromatographically fractionated with a mixture of butanol–glacial acetic acid–water (78 : 20 : 50). Radioautographs showed that for a short exposure time of 5 seconds, a spot due to the first product of the chemosynthesis contained most of the activity. The absence of this activity fraction in the 14-day culture was somewhat unexpected, because the rate of $C^{14}O_2$ fixation by the older culture was as rapid as that of the younger cultures. Three special experiments were then run which involved chemosynthesis, heterotrophic synthesis with malic acid as the organic nutrient and mixed synthesis. A significant increase in the radioactivity of the sugar fraction was observed in going from the heterotrophic fixation of $C^{14}O_2$ to chemosynthesis. (TTT)

24649 ISOLATION OF FULLY DEUTERATED METABOLITES FROM SCENEDESMUS OBLIQUUS GROWN IN DEUTERIUM OXIDE. M. I. Blake, H. L. Crespi, V. Mohan, and J. J. Katz (Argonne National Lab., Ill.). J. Pharm Sci., 50: 425-9(May 1961).

Successful mass culturing of Scenedesmus obliquus in

99.6% deuterium oxide proved to be a lucrative source of fully deuterated compounds. Whole cells are separated into three parts: hot water extract, crude pigments, and dry residue. The dry residue is hydrolyzed in acid. Five monosaccharides were identified in the nonionic fraction of the hydrolysate. Deuterio-mannose and deuterio-glucose were isolated in greater than gram amounts on a cellulose chromatographic column. Twelve amino acids were detected in the ionic fraction. Deuterio-alanine, deuterio-glutamic acid, deuterio-aspartic acid, and deuterio-glycine were separated in pure form by passage through a column of Dowex 50. The isolation, identification, and properties of these fully deuterated compounds are described. (auth)

24650 RELATIVE APPLICABILITY OF THE CLASSICAL AND THE BALANCE HYPOTHESES TO MAN. ESPECIALLY WITH RESPECT TO QUANTITATIVE CHARACTERS. Motoo Kimura (Inst. of Genetics, Mishima, Japan). J. Radiation Research (Japan), 1: 155-64(Sept. 1960). (In English)

Contrasting properties of the classical and the balance hypotheses as applied to quantitative characters were examined in the light of existing data in human genetics. It was concluded that among the loci concerned with a quantitative character in man, overdominant loci are in minority as compared with loci in which genetic variability is maintained by mutation and selection, though the former loci may contribute a large fraction to total genetic variability in the quantitative character. (auth)

24651 THE FEATURES PECULIAR TO THE CHRONIC EFFECT OF CERTAIN RADIOACTIVE ISOTOPES IN EXPERIMENT. E. B. Kurlyandskaya. Med. Radiol., 6: No. 4, 58-63(Apr. 1961). (In Russian)

Data are given dealing with the features peculiar to the chronic action of certain radioactive isotopes inside the organism. The importance of the nature of radioactive compounds (soluble and insoluble) upon their intratracheal introduction, as well as of local doses and the duration of the effect in the formation of tumors in the lungs is discussed. (auth)

24652 ON THE ORIGIN AND PLANETARY DISTRIBUTION OF LIFE. Carl Sagan (Univ. of California, Berkeley). Radiation Research, 15: 174-92(Aug. 1961).

Current opinions and speculations are discussed concerning the origin and early history of life on Earth, with particular emphasis on the role that radiation may have played, and with application to the problem of extraterrestrial life. The production of organic molecules in the atmosphere and on the surface of the primitive Earth is outlined, and the origin of the first self-replicating system from these molecules is discussed. The radiation hazards to the first organisms are examined, and possible radiation defense mechanisms and their relation to the early evolution of life are described. The application of these concepts to the possibility of life on other astronomical bodies is discussed. (auth)

24653 IXTH INTERNATIONAL CONGRESS OF RADIOLOGY. 23. VII–30. VII. 1959 IN MÜNCHEN, TRANSACTIONS. Vols. 1 and 2. B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. 1703p. $60.00–DM 240.

Volume 1 contains 112 complete papers and abstracts of 283 additional papers. Fifteen of these papers were abstracted separately for NSA. Volume 2 contains 136 complete papers and abstracts of 290 papers. Abstracts were prepared for 66 papers in this volume. Abstracts appear in this category and under Biology and Medicine–Radiation Effects on Living Tissues,–Radiation Sickness,–Biochemistry, Nutrition, and Toxicology, and under Health and Safety. (P.C.H.)

24654 MEASUREMENT OF ABSORPTION BY BONES OF MONOCHROMATIC X-RAYS. W. Frommhold and G. Schoknecht. p.251-4 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

In determining bone absorption of x rays by photographic measurements, three principal difficulties arise: (1) A displacement of the spectrum occurs when x rays of broad spectral distribution are used; (2) The utilization of photographic recording methods in absorption measurements stipulates a certain inaccuracy; and (3) The photographic method necessitates the utilization of broad primary radiation fields. Through knowledge of these causes of error a method was developed to avoid the difficulties. The measurement arrangement and the evaluation method are represented schematically. Typical absorption curves for fingers showing the age variations are presented. (J.S.R.)

24655 SPECTRAL DISTRIBUTIONS IN A MEDIUM IRRADIATED WITH X- OR GAMMA-RAYS. D. V. Cormack. p.1400-5 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Most primary spectral data available for x rays are between 50 and 400 kv. The total-absorption scintillation spectrometer is the most suitable instrument for this range. The thick-target-formula for describing the shape of a spectrum as a function of energy and filtration is compared with recent measurements. If a total-absorption spectrometer is coupled with a suitable phantom, the scattered radiation traveling in various directions may be measured. Integration over all angles may be performed numerically or graphically to obtain a complete spectrum of the scattered radiation. If direction does not matter the total spectrum is used. Comparisons of various measurements are given. (P.C.H.)

24656 PHYSICS AND TECHNIQUE OF AUTORADIOGRAPHY. R. H. Herz (Kodak, Ltd., Wealdstone, Middx, Eng.). p.1472-8 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Three autoradiographic techniques exist by which a quantitative assessment of tracer present in biological tissue can be derived. The methods are referred to as: (1) high grain density (visible blackening) method; (2) low grain density method; (3) particle track method. Resolution was found to depend on the distance between each element of the source and the emulsion, thickness of the emulsion, grain size, and range of the particle concerned. Different approaches are discussed, and optimum concentrations of radioactive material are suggested. (P.C.H.)

Biochemistry, Nutrition, and Toxicology

24657 (AF-SAM-61-65) THE EFFECT OF VARYING PROTEIN CONCENTRATION ON THE INTERACTION OF PROTEINS AND BIS(2-GUANIDOETHYL) DISULFIDE. Bernard Shapiro (Albert Einstein Medical Center. Radiology Dept., Philadelphia). Jan. 11, 1961. 7p.

Issued by School of Aerospace Medicine, Brooks AFB, Tex.

Buffered solutions containing 0.0005 molar GED-S^{35} and

various concentrations of ten proteins were prepared and aliquots of each solution were irradiated by means of a Co γ source. The radiation products were separated by paper chromatography, scanned with a GM counter, and quantitatively measured by planimetry of the areas under the recorded radioactive peaks. Protein-binding of the protective agent was noted in the unirradiated solutions and appeared to increase with an increase in protein concentration. Protamine, gelatin, insulin, and gamma globulin bound very little of the protective agent. Radiation increased the amount of protein-binding in almost all the protein solutions. Urease showed the least radiation effect. Protein protection against the radiation-induced oxidation of GED-S^{35} was evidenced in 0.1% and 0.2% protein solutions by an increased amount of GED-S^{35} remaining in solution and a decreased percent of 2-guanidoethanesulfinic acid, taurocyamine, and sulfate appearing in the solution after irradiation. These results indicate that although interaction of GED with radicals is negligible in solutions containing large amounts of protein, radical catching by GED may still be significant in solutions where the protein concentration is low. (auth)

24658 (HW-68803) PLUTONIUM INHALATION STUDIES. IV. MORTALITY IN DOGS AFTER INHALATION OF $Pu^{239}O_2$. W. J. Bair and D. H. Willard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1961. Contract AT(45-1)-1350. 20p.

In 28 beagle dogs depositing 1 to 130 μc of plutonium dioxide by inhalation, deaths due to respiratory insufficiency occurred two months to a year after exposure. Lungs contained 95% and the bronchial lymph nodes 4% of the total plutonium content. Clinical symptoms included increased respiratory rates, 20% weight loss and marked lymphopenia. Histopathologic effects were confined to lungs and bronchial lymph nodes. It was concluded that initial deposition of 0.1 μc Pu^{239} per gram of lung would rarely cause death of a dog within a year. (auth)

24659 (ORO-415) THE METABOLIC EXCHANGE OF RADIOACTIVE ISOTOPES IN ISOLATED CELL SYSTEMS. Final Report. Chalmers L. Gemmill and D. R. H. Gourley (Virginia. Univ., Charlottesville). May 31, 1961. Contract AT(04-1)-263. 19p.

Results are summarized from a series of tracer studies on the mechanism of phosphate ion transfer in erythrocytes, the effects of insulin in skeletal muscle, K transfer in skeletal muscle and erythrocytes and the effect of insulin and cardiac glycosides, and the mechanism of thyroxine action. A list is included of publications resulting from these studies. (C.H.)

24660 MEASUREMENT OF ABSORPTION OF VITAMIN B_{12} BY WHOLE-BODY GAMMA SPECTROMETRY. P. G. Reizenstein, Eugene P. Cronkite, and S. H. Cohn (Brookhaven National Lab., Upton, N. Y.). Blood, 18: 95-101(July 1961). (BNL-5274)

A technic is described to measure directly the intestinal absorption of radiovitamin B_{12} by using a whole-body gamma spectrometer. A double tracer technic is used, and the amounts of free and intrinsic factor bound vitamin B_{12}, respectively, retained in the body after final excretion of unabsorbed radioactivity, are measured. The present method is simple and quantitative. The primary advantage of the whole-body counter for measuring absorption of Cobalt-labeled B_{12} is that is can measure less than 0.1 μc with a high degree of accuracy. Whole-body counting substitutes a rapid and simple measurement for the difficult and tedious collection and radiochemical analysis of excreta. (auth)

24661 EFFECTS OF SOME PYRIMIDINE ANALOGUES ON THE FORMATION OF CIRCULATING ANTIBODY. Miroslav M. Simić, Vojin S. Šljivić, and Milica Ž. Petković. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 235-45(Mar. 1961). (In English)

Using the technique of titrating hemolysin in 50% hemolytic units it has been found that among several pyrimidine analogues tested, only 5-bromouracil had a marked inhibitory effect on the primary immune response. The possible mechanism of this inhibition in relation to the biosynthesis of nucleic acids has been discussed. (auth)

24662 THE CONCENTRATION OF CESIUM-137 IN HUMAN TISSUES AND ORGANS. Noboro Yamagata and Toshiko Yamagata. Bull. Inst. Public Health (Tokyo), 9: No. 2, 72-8(June 1960). (In English)

Human rib-bones and tissues from 18 autopsies of instantaneous death in Tokyo during the period August 1958 to July 1959 were collected and analyzed for cesium-137 and potassium. The result indicated the normal existence of cesium-137 in bone with comparable order as in muscles of concentration on the fresh weight basis. The average was 0.353 $\mu\mu$c per fresh gram of bone and 0.320 $\mu\mu$c for nuscle. The average concentration in the other organs is lower by factor of two or more. The concentration of cesium-137 on the basis of potassium (cesium unit) is highest in bone. As the cesium is properly expected to be present in bone marrow itself rather than in hard bone tissue because of its chemical properties, the beta radiation dose of cesium-137 to bone marrow might not be neglected as compared with that of strontium-90. (Public Health Eng. abstr., 61: No. 6, 1961)

24663 UPTAKE AND EXCRETION OF CESIUM^{134} AND POTASSIUM^{42} IN LACTATING DAIRY COWS. R. G. Cragle. J. Dairy Sci., 44: 352-7(Feb. 1961).

Eight lactating dairy cows were each given 1 mc of Cs^{134} and 6 mc of K^{42} in a single oral dose. An average of 6.7% of the Cs^{134} and 4.2% of the K^{42} was secreted into milk in 66 hr. Corresponding values for urinary excretion were 19.0 and 38.0%. Averages of 10.5, 30.0, and 32.7% of the cesium^{134} were found in milk, urine, and feces, respectively, in 210 hr. The variation in Cs^{134} and K^{42} secreted into milk can largely be explained on the basis of differing milk yields, with concentration remaining somewhat constant. The concentration of Cs^{134} and K^{42} in urine and the volume of urine are both highly variable. (Public Health Eng. abstr., 61: No. 6, 1961)

24664 STUDIES IN THE METABOLISM OF CARRIER-FREE RADIORUTHENIUM. I. PRELIMINARY INVESTIGATIONS. R. S. Bruce and T. E. F. Carr (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 14: 9-17(Apr. 1961). (In English)

Carrier-free radioruthenium (Ru^{106}) in different chemical forms is administered orally to rabbits and rats and the uptake and distribution in the body are determined. Derivatives of nitrosyl-ruthenium are absorbed to the greatest extent, uptake averaging 13 per cent by rabbits and 8 per cent by rats. The uptake of ruthenium chloride is lower and does not differ significantly from that of the dioxide in the absence of carrier. Uptake of all forms is rapid but a high proportion of the dose absorbed is excreted in the urine within 3 days. While the chemical nature of ruthenium considerably affects absorption, it does not influence the subsequent distribution. For the first few days after ingestion of ruthenium, the gastrointestinal tract and the kidneys are subjected to the highest concentrations of ruthenium. (auth)

24665 STUDIES ON THE DISTRIBUTION OF Cs^{137} IN RATS. II. DISTRIBUTION OF Cs^{137} IN RATS DURING PREGNANCY AND LACTATION. Yasushi Nishiwaki (Tokyo Inst. of Tech.), Hiroshi Kawai, Kazuo Matsumoto, Kazuhiko Mikota, Masako Yamada, Hiroshige Morishima, and Toshihiko Furukubo. J. Radiation Research (Japan), 1: 144-9(Sept. 1960). (In English)

The distributions of Cs^{137} in the pregnant rats and the parent rats during lactation are studied and discussed in comparison with the distribution in normal rats. The percentage of retention was observed to be lower with the pregnant rats than with the non-pregnant normal ones. The transfer of Cs^{137} to the fetus after the administration of Cs^{137} to the pregnant mother and the transfer of Cs^{137} to the baby from the parent during lactation after the administration of Cs^{137} to the parent are also studied. The fetus showed relatively low concentrations as compared with the pregnant mother. The tissue concentrations of the organs except blood were higher with the normal in the ratio roughly about two to one as compared with the parents during lactation. However, the concentration in blood was much higher with the rats during lactation than with the normal. Therefore it may be inferred that the tissue concentrations of the baby rats tend to be in equilibrium with those of the parent during lactation, if the baby is continuously fed with the milk of the parent that is receiving a continuous supply of Cs^{137}. (auth)

24666 STUDIES ON THE DISTRIBUTION OF COLLOIDAL RADIOACTIVE ISOTOPES ADMINISTERED IN NORMAL AND ASCITES TUMOR BEARING MICE. Tokutaro Miyauchi (Osaka City Univ.). Ôsaka Shiritsu Diagaku Igaku Zasshi, 9: No. 10, Suppl. 3, 3609-23(Oct. 1960). (In Japanese)

The distribution of colloidal radioactive isotopes was studied in normal and tumor-bearing mice as a function of time, route of administration, and the medium in which the element was dissolved. Data are presented on the distribution of radioactive colloidal Au, chromic phosphate, and lutetium chloride. (C.H.)

24667 RADIOLOGICAL AND ELECTRON MICROSCOPICAL STUDIES ON ThO_2-COLLOID ADOPTED IN THE LIVER AND SPLEEN. Shushi Nakamura (Osaka City Univ.). Ôsaka Shiritsu Diagaku Igaku Zasshi, 9: No. 11, Suppl. 4, 4113-21(Nov. 1960). (In Japanese)

The distribution of ThO_2 in the tissues of mice and rabbits was followed radiologically after intravenous injection. ThO_2 was also observed in hepatic cells with an electron microscope. ThO_2 particles were concentrated in reticuloendothelial cells of liver and spleen. (C.H.)

24668 THE MEASUREMENT OF LOCAL CORTICAL BLOOD FLOW IN THE BRAIN BY THE ANALYSIS OF THE CLEARANCE CURVE OF KRYPTON-85. H. I. Glass, A. M. Harper, and M. M. Glover (Western Regional Hospital Board, Glasgow and Univ. of Glasgow). Phys. in Med. Biol., 6: 65-71(July 1961).

A new technique of measuring local cortical blood flow in the brain is described. The mathematical analysis relating the clearance curve to the blood flow is derived. The assumptions of the method are discussed and some preliminary results obtained using the technique are presented. (auth)

24669 THE METABOLISM OF AMERICIUM AND PLUTONIUM IN THE RAT. D. M. Taylor, F. D. Sowby, and N. F. Kember (Royal Cancer Hospital, London). Phys. in Med. Biol., 6: 73-86(July 1961).

The distribution and retention of the alpha-emitting nuclides americium-241 and plutonium-239 in the tissues and bones of rats were studied over a period of about 600 days following intravenous injection. The biological half-lives of americium and plutonium were found to be 1600 and 1320 days, respectively. Autoradiographic techniques were used to study the microscopic distribution of the nuclides in bone and to estimate the distribution of radiation dose resulting from the deposition of americium-241 in the femur. (auth)

24670 TISSUE DISTRIBUTION OF MONOMERIC AND POLYMERIC PLUTONIUM AS MODIFIED BY A CHELATING AGENT. J. Schubert, J. F. Fried, M. W. Rosenthal, and A. Lindenbaum (Argonne National Lab., Ill.). Radiation Research, 15: 220-6(Aug. 1961).

Mice injected with a polymeric (colloidal) solution of Pu retained more of the radioelement in the liver and spleen and less in the bone than did mice injected with a monomeric plutonium solution. Daily DTPA therapy was initiated 3 days later, and the level of the radioelement in bone was reduced about one-half in each case. The liver burden of mice injected with the monomeric form of Pu was nearly completely removed after a few days of treatment, but that of mice injected with the polymeric form was reduced slowly and by only about one-third. (auth)

24671 EFFECT OF CHELATING AGENT ADMINISTRATION ON THE REMOVAL OF MONOMERIC AND POLYMERIC THORIUM. J. F. Fried and J. Schubert (Argonne National Lab., Ill.). Radiation Research, 15: 227-35(Aug. 1961).

Monomeric and polymeric Th were compared with respect to their distribution and ease of removal after injection into rats. In addition, the comparative efficiency of two chelating agents, DTPA and EDTA, for removal of Th deposited in monomeric form was evaluated. Monomeric Th is retained mainly in the skeleton, and treatment with DTPA, begun 2 days after injection of Th, removed about one-third of this. EDTA given at this time was practically ineffective. Polymeric thorium was deposited mainly in the liver. Treatment with DTPA, initiated 3 days later, produced no effect when given at therapeutic levels; however, when massive, near-toxic doses were administered, the liver content was significantly lowered. The reasons for these differences are discussed. (auth)

24672 INTERNAL CONTAMINATION AND ITS TREATMENT. Jack Schubert (Argonne National Lab., Ill.). p.1251-7 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Georg Thieme Verlag, 1961. (In English)

The action of chelating agents in hastening the elimination of radioelements deposited in the body is described. Specifically, the effectiveness of ethylenediaminetetraacetic acid (EDTA) is compared to that of diethylenetriaminepentaacetic acid (DTPA) with respect to its ability to hasten the elimination of Pu and Th. The data show that DTPA is much more effective than EDTA against trivalent and tetravalent radioelements. Ultrafiltration studies of the radioelements deposited in tissues before and after treatment with a chelating agent prove that a diffusible chelate is formed within the tissues, and diffusibility of the chelate remains well above the control levels for at least a week. This explains the observation that, following a single injection of chelating agent, the urinary excretion of the radioelement remains well above control levels for several days afterward. When the polymerized form of the radioelement is injected, the chelating agent is much less effective. This is attributed to the slow rate at which the chelating agent depolymerizes the inorganic polymer. While, subsequent injections of the chelating agent cause the urinary excre-

tion of the polymerized element to be greater than the following earlier injections—the opposite effect is observed with the nonpolymeric or "ionic" form of the same radioelement. The question of the possible effectiveness of chelating agents such as EDTA against Sr^{90} is discussed. Calculations based on mass action equations show that it is highly improbable that these chelating agents can affect the excretion of Sr^{90}. Other calculations show that it is impractical to effect the removal of Sr^{90} by the administration of the stable isotope. (auth)

24673 MEASUREMENT OF VERY SMALL RADON CONCENTRATION BY SCINTILLATION APPARATUS. A. Kaul and H. Muth (Max-Planck-Institut für Biophysik, Frankfurt am Main). p.1391-6 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

In determining the radium content of the human body from measurements of the radon exhaled, it is necessary to measure very small radon concentrations. Two scintillation arrangements were developed with which radon concentrations of 10^{-13} c can be measured in a short time with sufficient accuracy. The electronic part of the apparatus consists of a photomultiplier with cathode amplifier, an amplifier, and a counter apparatus. The performance and operation of the instrument are described. (J.S.R.)

24674 MINERAL METABOLISM. AN ADVANCED TREATISE. VOLUME 1. PART B. PRINCIPLES, PROCESSES, AND SYSTEMS. Cyril L. Comar and Felix Bronner, eds. New York, Academic Press, 1961. 542p.

The hormonal regulation of mineral metabolism and the major tissues that are the principal reservoirs for minerals in the body, such as bones, teeth, and connective tissue, are discussed. Some of the enzymatic processes that are dependent on mineral and metal activation are interpreted. Lists of references and author and subject indexes are included. (C.H.)

Fallout and Ecology

24675 DIRECT AND FOOD-CHAIN UPTAKE OF CESIUM^{137} AND STRONTIUM^{85} IN BLUEGILL FINGERLINGS. Louis G. Williams and Quentin Pickering. Ecology, 42: 205-6(Jan. 1961).

Bluegill fingerling fish, accumulating Cs^{137} and Sr^{85}, by way of the Euglena-Daphnia food chain, show higher concentration and retention of these nuclides after 48 hours than by direct uptake from water. Apparently some of these radionuclides, which have been taken up by Euglena, are bound to a chemical mechanism. This bound condition enables them to pass along a food chain through Daphnia into bluegills. Thus, higher concentrations and retentions of these radionuclides were obtained from the food chain route than from solutions in which the organisms were submerged. (Public Health Eng. abstr., 61: No. 6, 1961)

24676 UPTAKE OF POTASSIUM AND CESIUM FROM WATER BY THE SOCKEYE SALMON. Ryushi Ichikawa (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiation Research (Japan), 1: 107-10(Sept. 1960). (In English)

The difference in the behavior of cesium and potassium in the water–fish relation was investigated. The uptake ratios from water into fish varied remarkably with the concentration in the water. The ratio Cs/K taken into fish was approximately proportional to the square of the ratio in water. (auth)

Radiation Effects on Living Tissues

24677 (NP-10372) EFFECT OF X-IRRADIATION ON BLOOD CELLS AND TISSUES. Final Report for Period October 1, 1952–June 30, 1961. Report 513(Final). Milton A. Lessler (Ohio State Univ. Research Foundation, Columbus). June 1961. Contract DA-49-007-MD-293. 31p.

A review is given of significant findings on the effect of x-irradiation on the cytophysiology of blood cells. Evidence of cytological, histochemical, and biophysical changes are related to changes in respiratory activity of frog and amphiuma red cells noted following x-ray doses of 100 and 200 r in vitro. Recent studies of x-ray damage to frog blood cells at the electron microscope level of resolution are presented. The studies indicate that a dose of 1000 rads results in the disruption of the ultra-structure of red cell mitochondria and in the appearance of vacuoles in the cytoplasm of leukocytes. The metabolism of freshly prepared and blood-bank stored human erythrocytes incubated in autologous plasma or physiological saline solution was compared. Erythrocyte respiration and glycolysis was greater in plasma than in saline. Glycolysis of unirradiated and 700 r x-irradiated red cells was approximately equal in the normal range of blood glucose levels, but at higher or lower glucose levels in vitro x-irradiation inhibited glycolysis. Exposure of blood-bank stored erythrocytes to x-ray doses of 700 or 1400 r did not materially alter their respiratory activity. A comparison of the endogenous respiration of rat liver and spleen slices after in vitro x-irradiation of 300 and 1200 r is reported. (auth)

24678 (TID-13218) GENETIC EFFECT OF IRRADIATING SWINE. Progress Report No. 2. (Iowa State Univ. of Science and Tech., Ames). July 1961. Contract AT(11-1)-707. 30p.

Results are summarized from a study on the genetic effects of radiation in swine. Data are included from immunogenetic studies of the genes responsible for blood antigens and mutation rates at specific loci, the direct effects of 300 r x radiation on sperm production and fertility in boars, and the genetic effects of radiation in the offspring of irradiated males. (C.H.)

24679 (UR-586) THE EFFECT OF OXYGEN TENSION ON THE RADIOSENSITIVITY OF THE CHICK EMBRYO. Betty Henderson Hopkins and L. W. Tuttle (Rochester, N. Y. Univ. Atomic Energy Project). Jan. 19, 1961. Contract W-7405-eng-49. 145p.

The purpose of this research was to examine the relationship between oxygen tension at the time of exposure and the amount of radiation damage induced in a vertebrate species. Chick embryos were exposed to Co^{60} γ radiation at three different oxygen tensions. Subsequent growth, development, and pathological effects were examined and assessed quantitatively where possible. Embryos of 22 hrs total incubation age irradiated in 100% oxygen at 3 atm pressure showed a greater degree of growth retardation than groups similarly treated in air at 1 atm and N at 3 atm, respectively. If the number of differentiated somites at 22.5 hrs post treatment is used as a measure of effect, then the amount of radiation required to reduce the number of somites to 50% of that found in control embryos is three times greater when oxygen tension is reduced from 2258 mm Hg to zero. Similar studies with the 4-day embryo also showed an oxygen dependent response when the $LD_{50}/7$ hrs is used as the criterion of effect. Gross pathological examination of whole embryos disclosed a radiation response which paralleled the results obtained with quantitative measurements. (auth)

24680 (JPRS-9339(p.99-114)) THE EFFECT OF X-IRRADIATION ON CELL DIVISION IN THE MUCOSAL EPITHELIUM OF THE TONGUE. G. N. Orlova. Translated from Tsitologiya, 3: No. 1, 67-74(1961).

Exposure of rats to whole-body doses of 700 r of x radiation caused disturbances in the division of cells in the stratified squamous epithelium of the mucosal surface of the tongue. The histological features of the observed changes are described. (C.H.)

24681 (JPRS-9339(p.115-31)) THE EFFECT OF X-RAYS ON RAT EMBRYO CELLS DURING THE PRE-IMPLANTATION PERIOD OF GROWTH. N. A. Samoshkina. Translated from Tsitologiya, 3: No. 1, 75-84(1961).

Exposure of pregnant female rats to doses of 400 r of x radiation during the preimplantation period caused serious disturbances both to the nuclei and to the cytoplasm of embryo cells. A typical mitosis, seen within 24 hr, was followed by marked degenerative changes in the embryo cells. (C.H.)

24682 (JPRS-9339(p.179-84)) EARLY CYTOLOGIC CHANGES OF LEUKOCYTES AFTER X-IRRADIATION OF PERIPHERAL BLOOD IN VITRO. T. M. Kondrat'eva (Kondrat'yeva) and R. I. Pinto. Translated from Tsitologiya, 3: No. 1, 106-8(1961).

Changes in leukocytes of the peripheral blood of rats induced by x irradiation in vitro were studied by fluorescent microscopy. Injury to cells was seen to occur immediately upon exposure. Injury began with changes in nuclear structure and terminated with disintegration of the cell. The degree of injury increased with increased dose. Injury reached a maximum 3 to 4 hr after irradiation. (C.H.)

24683 (JPRS-9412) EFFECT OF RADIOACTIVE PHOSPHORUS ON THE CONTENT OF PROTEINS, RESIDUAL NITROGEN, AND UREA IN THE BLOOD UNDER CONDITIONS OF MEDICALLY INDUCED SLEEP. I. V. Savits'kii (Savyts'kyy). Translated from Ukrain. Biokhim. Zhur., 32: No. 1, 22-9(1961). 12p.

Narcotic sleep, induced by barbamyl, caused an increase in the levels of protein, residual N, and urea in the blood of rabbits receiving injections of P^{32}. Disturbances were also noted in the levels of albumin, globulin, and fibrinogen. Data are tabulated. (C.H.)

24684 (JPRS-9439) CHANGE IN THE CONTENT OF MACROERGIC PHOSPHORUS COMPOUNDS IN THE TISSUES IN ACUTE RADIATION SICKNESS. D. A. Golubentsev. Translated from Voprosy Med. Khim., 7: 28-32(1961). 10p.

Rats and dogs were subjected to total irradiations of 750 to 900 r and 400 to 600 r, respectively. Macroergic phosphorus compound contents were determined within 30 to 60 min, 3 to 4 and 24 to 48 hr, 5 to 6, 8 to 13, 31 to 40, and 75 to 98 days following irradiation in the tissues of the spleen thymus, small intestine, liver, and skeletal muscles. (B.O.G.)

24685 (JPRS-9521) EFFECT OF SMALL X-RAY DOSES ON THE EXTINGUISHING INHIBITION IN RABBITS. I. V. Malyukova. Translated from Zhur. Vysshei Nervoni Deyatel'nosti im. I. P. Pavlova, 11: No. 1, 165-8(1961). 6p.

Results of a series of studies on the effects of small doses of x radiation on the nervous system led to the conclusion that whole-body exposure of rabbits produces changes in conditioned reflex activity. A disturbance of normal correlation of excitation and inhibition processes in the higher centers of the central nervous system was demonstrated. (C.H.)

24686 (NP-tr-694) HEAT SENSITISATION AND REACTIVATION OF X-IRRADIATED COLI BACTERIA. H. Langendorff, M. Langendorff, and K. Sommermeyer. Translated by J. B. Sykes for U.K.A.E.A. Atomic Energy Research Establishment from Z. Naturforsch., 8b: 117-22 (1953). 14p.

Results of experiments on the heat sensitization and reactivation of x irradiated E. coli showed that raising the temperature above the range of 37°C normally used for cultures of E. coli increased the number of bacteria that form colonies. Heat sensitization apparently occurred because the bacteria, under heat treatment, change into a different form. E. coli bacteria inactivated by x rays were reactivated by subsequent heat treatment. The differences in the effects of ultraviolet and x radiation were shown to be qualitative, but not quantitative. Reversible and irreversible primary damage was shown to be caused with either kind. The nature of primary damage and reaction mechanisms involved in sensitization and reactivation are discussed. (C.H.)

24687 THE ACTION OF ULTRAVIOLET RADIATION ON MAMMALIAN CELLS VIABILITY AND METABOLISM OF NUCLEIC ACID. Lj. Kostić, O. Čečuk, and D. Kanazir. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 209-17(Mar. 1961). (In English)

A strain of mammalian cells, L-strain mouse cells, has been used for the study of the effects of uv irradiation on the rates of RNA and DNA biosynthesis and on the cell viability. Exponentially dividing cells were irradiated with 800 ergs/mm^2/min., a dose which induces continuous death, i.e., loss of reproductive capacity. In irradiated cultures RNA and DNA synthesis measured by the isotope-dilution technique during 2 days after irradiation was markedly depressed. After this interval there is an increase in the total amount of nucleic acids per culture and per cell as well as faster dilution of their specific activities indicating that the synthesis of nucleic acids is restored and that it proceeds at a rate markedly slower than in normal cells. In spite of this fact the irradiated cells continue to die. The total RNA synthesis was more affected by uv irradiation in mammalian cells than in microorganisms. (auth)

24688 SOME CHANGES OF PHYSICAL-CHEMICAL PROPERTIES OF DEOXYRIBONUCLEIC ACID ISOLATED FROM SALMONELLA TYPHIMURIUM IRRADIATED BY UV AND GAMMA RAYS. Vladimir R. Glisin, Tamara Hudnik-Plevnik, Marta M. Simić, and Dusan T. Kanazir. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 219-27(Mar. 1961). (In English)

Data show that significant changes of physical-chemical properties occur in deoxyribonucleic acid (DNA) isolated from irradiated bacteria 180 minutes after uv or gamma irradiation. All alterations point out the quantitative changes in the base composition of DNA synthesized de novo after irradiation. However, immediately after irradiation no significant or no changes at all could be observed. (auth)

24689 QUANTITATIVE CHANGES IN THE BASE COMPOSITION OF DESOXYRIBONUCLEIC ACID (DNA) EXTRACTED FROM UV IRRADIATED SALMONELLA TYPHIMURIUM. Tamara Hudnik-Plevnik and Marta M. Simić. Bull. Inst. Nuclear Sci. "Boris Kicrich" (Belgrade), 11: 231-3(Mar. 1961). (In English)

After uv irradiation of Salmonella Typhimurium a change in base composition in its desoxyribonucleic acid (DNA) is observed. Irradiated organisms contain a lower proportion of thymine in its DNA, this difference amounting to 12% compared to controls. (auth)

24690 CONTRIBUTION TO THE INVESTIGATION OF THE EFFECTS OF X-IRRADIATION ON ANTIBODY FORMATION DURING THE SECONDARY IMMUNE RESPONSE. Vojin S. Šljivić, Miroslav M. Simić, and Milica Ž. Petković. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 247-54(Mar. 1961). (In English)

The secondary hemolysin response was compared with the primary in normal and x-irradiated rats. It has been found in rats irradiated with 500 r, that the secondary response was, under the same experimental conditions, relatively more radioresistant than the primary response. Irradiation before the secondary response damaged mostly the antibody production phase, while the induction period was found to be much shorter than in animals irradiated before the primary response. (auth)

24691 THE ROLE OF THE TIME RELATION BETWEEN IMMUNIZATION AND IRRADIATION ON THE INHIBITION OF THE PRIMARY HEMOLYSIN RESPONSE IN RATS. Miroslav M. Simić and Vojin S. Šljivić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 255-74(Mar. 1961). (In English)

Using the technique of titrating hemolysin in 50% units and methods of obtaining antibody curves for each rat, the effects of varying time sequences between immunization and x irradiation on the primary immune response were studied. The immune response was found to be significantly depressed when rats were immunized from 3 days before to 5 days after irradiation. The degree and the type of inhibition were however dependent on the time factor. Immune response data were analysed in comparison with the hemolysin response in the rabbit and some differences were found. The possible mechanism of radiation effects on antibody formation was discussed in connection to the alteration of nucleic acid biosynthesis after irradiation. A particular role of the changes in DNA biosynthesis after x-irradiation for the depression of the immune response was stressed. (auth)

24692 EXPERIMENTALLY INDUCED MUTATIONS IN TOMATOES. M. I. Kulik (Inst. of Cytology and Genetics, Siberian Branch, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 211-14(May 1, 1961). (In Russian)

Gamma rays, thermal neutrons and x rays were used on various kinds of tomatoes such as Pushkinskii, Gruntovyi Desertnyi ("Prime Dessert"), Shtambovyi Karlikovyi ("Dwarf Stem"), and Bizon ("Bison") to produce mutations with such valuable characteristics as early maturation, uniformity of stand, and greater productivity. Doses of >10,000 r of x rays or gamma rays on air-dried seeds resulted in poorly developed plants which bore no fruit. The greatest variety of induced mutations were observed at relatively small doses of 1000 to 5000 r of gamma rays. Thermal neutron doses from 1×10^9 to 4×10^{10} per cm^2 were effective in producing mutations, but a thermal neutron dose of 4×10^{12} per cm^2 damaged the plants. Gamma rays produced a greater variety of mutations as compared with thermal neutrons. The germination and viability of air-dried seed were greater on irradiation with gamma rays than an irradiation with the same dose of x rays. The frequency of the mutation rate was increased by a factor of 10 to 15 by irradiation as compared to the natural spontaneous mutation rate. Most of the mutations (>70%) resulted in mature developed plants of which about 30% possessed characteristics which would be of interest for selection purposes. (TTT)

24693 THE EFFECTS OF X-IRRADIATION ON THE VITAMIN EXCRETION OF THE RHESUS MONKEY (MACACA MULATTA). José Eduardo Dutra De Oliveira, William N. Pearson, Krishna P. Misra, Granville W. Hudson, and William J. Darby (Vanderbilt Univ. School of Medicine, Nashville). J. Nutrition, 59: 527-37(Aug. 1956).

Ten monkeys were exposed to three levels (325, 400, 650 r) of x radiation. Anorexia, leucopenia, loss of hair, and at the high levels of irradiation, hemorrhage and diarrhea, followed. Observations on pair-fed non-irradiated controls demonstrated that the decreased urinary excretion of riboflavin, thiamine, and N^1-methylnicotinamide which followed irradiation was a result of food restriction, not a specific effect of the x-ray injury. No meaningful changes could be found in blood ascorbic acid at the levels of irradiation and intake. Diketogulonic acid excretion was increased in urine after irradiation. A temporary, moderately increased excretion of pteroylglutamic acid and of vitamin B_6 followed x-irradiation. No prolonged loss of ascorbic acid, riboflavin, thiamine, niacin (N^1-methylnicotinamide), pyridoxine, or pteroylglutamate occurs which might indicate that x radiation is a conditioning agent in producing a deficiency of these factors. (auth)

24694 ENHANCEMENT OF RADIATION LETHAL EFFECT ON MICROORGANISMS BY SODIUM CHLORIDE TREATMENT DURING IRRADIATION. Akira Matsuyama (Univ. of Tokyo), Yoshishige Okazawa, Mitsuo Namiki, and Yusuke Sumiki. J. Radiation Research (Japan), 1: 98-106 (Sept. 1960). (In English)

Enhancement of radiation lethal effects on microorganisms by NaCl during irradiation is observed. The effects of radiation dose, dose rates, cell concentration, and pre-irradiation on this phenomenon are investigated. The enhancing action appears to have no direct correlation to NaCl tolerance of cells. Its possible mechanism is discussed from a viewpoint of free radical hypothesis. (auth)

24695 BIOCHEMICAL EFFECTS OF GAMMA IRRADIATION ON THE SUCCINOXIDASE SYSTEM, IN VITRO. Shozo Tanaka, Shigetake Ganno, and Hiroyuki Hatano (Kyoto Univ.). J. Radiation Research (Japan), 1: 120-3(Sept. 1960). (In English)

The succinoxidase system and each component enzyme, i.e., succinic dehydrogenase and cytochrome oxidase, obtained from the liver of mice and rats and from beef heart, were irradiated in vitro with cobalt-60 γ rays. Inactivation of the enzyme systems was produced by relatively large doses of γ irradiation. Succinic dehydrogenase was found to be more radiosensitive than cytochrome oxidase in all preparations. The effect of gamma irradiation on the enzyme systems in mitochondria and nuclei of rat liver was compared. The enzyme systems in the nuclear fraction were relatively more radio sensitive to γ-ray inactivation than those in the mitochondrial fraction. (auth)

24696 RETINAL ANOMALY OF THE CHICK EMBRYO PRODUCED BY X-RAY IRRADIATION. Katsumoto Ueda (Defence Academy, Yokosuka, Japan), Kenzo Okabe, and Shutaro Yamamoto. J. Radiation Research (Japan), 1, 124-30(Sept. 1960). (In English)

The sensitivity of the chick embryo to radiation was investigated. Various degree of abnormalities from discontinuities of the outer nuclear layer to severe rosette formations were observed, and the dose-effect relationship in different irradiation stages were investigated. It was concluded that the most sensitive stage is 6-day old embryo, and it's minimal effective dose is 350 r. It was observed also that the situation of retinal anomaly in the eye globe depends on the embryonic stages irradiated. (auth)

24697 THE DISTRIBUTION OF Y^{91} AND THE LESION BY Y^{91}-BETA-IRRADIATION IN SPLEEN AND LIVER OF MOUSE. Mikita Kato (Kyoto Univ.), Atsuhiko Takeda, and Yasuhiko Takamori. J. Radiation Research (Japan), 1: 131-43(Sept. 1960). (In English)

The rate of retention of Y^{91} in spleen and liver after intravenous injection was about 20 times higher than after intraperitoneal injection, but the distribution pattern was similar, i.e., Y^{91} was retained homogeneously in liver, but predominantly in the red pulp region in spleen. When mice were administered Y^{91} intravenously at the rate of 3 μc/g of body weight, the splenic weight was reduced exponentially with absorbed energy, and similarly, DNA content of spleen was decreased with tissue dose. These effects could be understood from consideration of disappearance of lymphocytes. RNA content of spleen was sensitively decreased. On the other hand, both the tissue weight and the nucleic acid content in liver showed scarcely any change. These studies indicate that liver and spleen result in different response against internal β radiation from Y^{91}, and thus, the general information that liver is radioresistant and spleen is radiosensitive can be fully accepted. (auth)

24698 LEUKEMIAS AND ALLIED DISEASES IN ATOM-BOMBED SURVIVORS. Tando Misao (Kyushu Univ., Fukuoka), Kenichi Hattori, and Matsuru Shirakawa. J. Radiation Research (Japan), 1: 165-74(Sept. 1960). (In English)

Four cases of leukemia and one case of reticulosarcomatosis as observed in A-bomb survivors are reported and the etiological relationship between A-bombing and development of these diseases was discussed. (auth)

24699 THE VASCULAR REACTION OF INTERNAL ORGANS TO ADRENALINE ADMINISTRATION IN RABBITS FOLLOWING TOTAL X-RAY IRRADIATION. L. D. Klimovskaya. Med. Radiol., 6: No. 4, 83-4(Apr. 1961). (In Russian)

The vascular reaction to adrenaline was studied in 56 male rabbits weighing 2.5 to 3.5 kg after irradiation at a distance of 60 cm by 29 to 33 r/min to a dose of 800 to 1000 r. The reaction of intestines was observed after injecting 0.1 to 10 γ/kg of adrenaline into the ear. The adrenaline caused rapid and pronounced vascular constriction of the vermiform appendix for 1.5 to 2 min. With the larger doses second constriction followed. The reaction of kidneys differed from that of the intestines; the maximum constriction was reached after 1 to 1.5 min and lasted 2 to 3 min. Correlations of the data for intestines, kidneys, and skin (in the initial and final stages the skin vessels are in a spasmodic state) indicate various functional differences. (R.V.J.)

24700 THE EFFECT OF PENTOXYL ON THE IMMUNITY INDICES OF THE IRRADIATED ORGANISM. E. A. Gurkova. Med. Radiol., 6: No. 4, 84-5(Apr. 1961). (In Russian)

The influence of pentoxyl on leukocyte phagocytic activity and antibody formation during immunization by streptococcus was studied under normal condition and in radiation injury. The results indicate that under both conditions pentoxyl stimulates leukocyte formation and increases their number in peripheral blood. However, in irradiated organisms it does not influence the condition of phagocytes or leukocyte activity. (R.V.J.)

24701 THE STATE OF THE CENTRAL NERVOUS SYSTEM IN ACUTE URANYL NITRATE POISONING. V. A. Nazarov. Med. Radiol., 6: No. 4, 85-7(Apr. 1961). (In Russian)

The functional condition of cerebral cortex injured by uranyl nitrate was studied in 24 rabbits. The results indicated uranyl induced considerable disturbance in the central nervous system. (R.V.J.)

24702 STUDIES ON VARIATIONS OF UNSATURATION OF LIPIDS IN SERUM BY THE EFFECT OF X-RAY IRRADIATION. Shigeo Amino (Osaka City Univ.). Ôsaka Shiritsu Diagaku Igaku Zasshi, 9: No. 10, Suppl. 3, 3597-3608(Oct. 1960). (In Japanese)

The changes in levels of iodine and lipids in blood serum of rabbits were measured after exposure to a single dose of 1000 r of x radiation and after exposure to a second dose of 1000 r 3 months later. The iodine value appeared to increase slightly. Lipid values varied qualitatively. (C.H.)

24703 EXPERIMENTAL STUDIES ON THE DIRECT AND INDIRECT EFFECT OF X-IRRADIATION UPON THE BONE MARROW. Yoshinori Fukui (Osaka City Univ.). Ôsaka Shiritsu Diagaku Igaku Zasshi, 9: No. 10, Suppl. 3, 3643-6(Oct. 1960). (In Japanese)

Observations are reported on the direct effects of x irradiation on the morphology of cells in the legs of rabbits. Indirect effects were measured by the uptake of P^{32} by bone marrow tissue. (C.H.)

24704 MOLECULAR AND CELLULAR EFFECTS OF FAST CHARGED PARTICLES. Tor Brustad (Univ. of California, Berkeley). Radiation Research, 15, 139-58 (Aug. 1961).

The radiosensitivity of enzymes, bacteriophage, bacteria, and yeast cells was studied as a function of the linear energy transfer (LET) of the radiations used. Very high LET values were obtained with monoenergetic beams of stripped nuclei with atomic number up through 10, accelerated in the heavy ion linear accelerator at the University of California, Berkeley. It was found possible to increase and decrease the radiosensitivity of dry enzymes when exposed to heavy ions, as is possible for radiation of lower LET. A mechanism is suggested to account for these effects, based on intermolecular energy transfer processes. It was shown that the relative biological effectiveness (RBE) for inactivation of dry enzymes and bacteriophage (in both wet and dry states) decreases continuously with increasing LET. The RBE for inactivation of haploid yeast cells (in N_2 and O_2) and for bacteria (in N_2) as well as for radiation induction of mutants in diploid yeast (N_2 and O_2) increases with increasing LET and then decreases when the LET exceeds a certain value characteristic of the various effects studied. It was found that the RBE's for induction of different mutants in diploid yeast at very high LET (Ne ions) differ by more than a factor of 5. For all the biological systems studied thus far, however, the RBE was declining after the LET exceeded 3000 Mev gm^{-1} cm^2. A more detailed understanding of the δ-ray effect is required for unequivocal test of existing radiobiological theories when heavy ions are used. 38 references. (auth)

24705 CROSSLINKING AND DEGRADATION OF DEOXYRIBONUCLEIC ACID GELS WITH VARYING WATER CONTENTS WHEN IRRADIATED WITH ELECTRONS. J. T. Lett and P. Alexander (Royal Cancer Hospital, London). Radiation Research, 15: 159-73(Aug. 1961).

DNA gels containing between 0 and 400% of water were irradiated with 1- and 2-Mev electrons. The changes in the viscosity, molecular weight, and solubility of the DNA were determined. The degradation of the molecule due to breaks of both strands in the twin helix becomes increasingly more efficient as the water content is increased. This is attributed to the free radicals formed in the water, and in the presence of oxygen indirect action is approxi-

mately 1.3 times as efficient as direct action in producing one double break. Direct action also leads to crosslinking, and the magnitude of this process depends both on the water content and on the presence of oxygen. In dry DNA crosslinking is relatively inefficient but is not greatly affected by the presence or absence of oxygen. Crosslinking occurs more readily in DNA gels swollen with water (up to 200% water content) as long as oxygen is absent. In such gels oxygen can completely prevent crosslinking. Insoluble DNA gels are produced by radiation so long as crosslinking predominates over degradation. As the moisture content is increased, the mobility of the molecules becomes greater and interaction between molecules occurs more readily. But at the same time the efficiency of degradation also becomes greater. These two opposing factors lead to the situation that the rate of gel formation for a dose of 10^6 rads at first increases as the moisture content goes up, but at about 200% of water it falls again, and above 300% water gel is not formed. It was concluded that direct action leads to the rupture of polynucleotide chains to give a reactive end that can, under sterically favorable conditions, combine intermolecularly to give a crosslink if there is no oxygen present. Double breaks (resulting in a scission of the DNA double helix) occur at regions of high ionization density. Radicals produced in the water produce single breaks that are not reactive and cannot give rise to crosslinks. Main-chain breaks occur from single breaks when there are two such breaks fairly close together in each of the chains. (auth)

24706 IRRADIATION OF PROTEINS IN THE SOLID STATE. III. INFLUENCE OF OXYGEN AND ABSORBED WATER ON CHANGES PRODUCED IN BOVINE SERUM ALBUMIN. P. Alexander and L. D. G. Hamilton (Royal Cancer Hospital, London). Radiation Research, 15: 193-201(Aug. 1961).

Solid bovine serum albumin was irradiated with 1- and 2-Mev electrons in the presence of oxygen and adsorbed water. Changes to solubility and accessibility of disulfide bonds and alterations to the protein side chains were examined. The presence of oxygen during irradiation of BSA with a 5% water content had no effect on the change in the physicochemical properties resulting from one ionization per molecule, i.e., change of shape revealing 25% of the disulfide bonds, but slightly enhanced the production of totally denatured protein with 50% disulfide bonds accessible. There is a trend toward increased change in the protein side chains, particularly decarboxylation and the formation of carbonyl groups. The latter are not formed from the peptide chain by the mechanism postulated for indirect action. These chemical changes could contribute to the increased insolubility observed during irradiation in oxygen. Irradiation of BSA in the presence of adsorbed water produced enhanced insolubility without a similar change to the available S—S bonds. This suggests that the initial denaturation stage is unaffected, and the additional insolubility is due to side-chain interactions. This would exclude significant intervention of indirect action up to water contents of at least 25 gm per 100 gm of protein. At high water contents the irradiated protein forms a crosslinked network and becomes insoluble in dilute salt solutions. A blue-colored trapped free radical of long life, sensitive to oxygen, nitric oxide, and water, was present after irradiation of the intensively dried BSA under high vacuum. These results support the original hypothesis that the initial loss of biological activity of heat-labile enzymes is the result of one ionization disrupting the secondary structure of the molecule. The increased inactivation in oxygen would appear to occur as a result of alterations to the main or side chains of the protein. (auth)

24707 COMPARISON OF EFFECTS OF I^{131}-INDUCED HYPOTHYROIDISM AND L-TRIIODOTHYRONINE ON IRRADIATED HAIR ROOTS IN MICE. Melvin L. Griem, Joseph A. Stein, Richard P. Reinertson, Paul Reinertson, and Blaine R. Brown (Univ. of Chicago and Argonne Cancer Research Hospital, Chicago). Radiation Research, 15: 202-10(Aug. 1961).

A study of differences in radiation response of hair roots of mice injected with L-triiodothyronine and I^{131} is presented. L-Triiodothyronine appears to potentiate the effects of radiation in producing dysplastic hairs in the mouse, whereas I^{131}-induced hypothyroidism appears to decrease the effect. (auth)

24708 DIFFERENCE IN REACTION TO X-IRRADIATION BETWEEN CHICKEN AND RABBIT LENS. Antoinette Pirie (Oxford, Univ.). Radiation Research, 15: 211-19(Aug. 1961).

Micronuclei did not appear in the lens epithelium of the chick after irradiation, although they are prominent in the irradiated lens epithelium of the rabbit. The chick and hen do not develop irradiation cataract. Some enzymes and constituents of the bird lens were compared with those of rabbit or calf to see whether a clue to the different histological and clinical reactions to radiation might be found, but no clear distinction was discovered. (auth)

24709 THE MODIFICATION BY X-IRRADIATION OF THE LIFE SPAN OF HAPLOIDS AND DIPLOIDS OF THE WASP, HABROBRACON SP. Arnold M. Clark and Mary Ann Rubin (Univ. of Delaware, Newark). Radiation Research, 15: 244-53(Aug. 1961).

Haploid males, diploid males, and diploid females of the wasp, Habrobracon sp., were x-irradiated as larvae-in-cocoons, white pupae, and adults, and their adult life span was obtained. The median life span for nonirradiated adults was 62 days for haploid males and diploid males, 92 days for diploid females fed on honey-water, and 40 days for diploid females fed on Ephestia larvae. The difference in life span is related to sex but not to genome number and suggests that the normal aging process is not due to an accumulation of somatic mutations. Although a nutritional factor may be involved in the life span of females, this cannot be resolved by the present experiments, since females that are fed honey-water do not lay eggs, whereas females that are Ephestia-fed lay eggs throughout their lives. Diploid males irradiated as adults (10000 to 50000 r) have a longer life span than comparable haploid males. Diploid males and diploid females show similar decreases in life span relative to their controls. Radiation-induced decrease in life span is markedly influenced by genome number but not by sex. This suggests that the decrease in life span by x irradiation is due to damage of a genetic nature. The differential sensitivity of haploid and diploid adults to x irradiation indicates that gene action is taking place in the adult stage and in nondividing cells. Pupae after exposure to 10000 and 15000 r are not inhibited in their ability to develop into structurally normal adults. These adults, however, show a decrease in life span. Haploid males have a markedly shorter life span than diploid males. Diploid males are similar to diploid females in decreased life span. This differential sensitivity is due apparently to genetic damage which becomes observable for groups of older adults. Larvae after exposure to 2000 r are able to develop into structurally normal adults. These adults, however, show a decrease in life span. Haploid males are similar to honey-fed females. Ephestia-

fed females show a considerable decrease in life span for reasons that are not clear. The differential sensitivity of haploids and diploids is different for the larval, pupal, and adult stages. This is probably related to different types of genetic injury such as effects on cell division and on gene action occurring in different stages of development. (auth)

24710 CORRELATION OF NUCLEAR VOLUME AND DNA CONTENT WITH HIGHER PLANT TOLERANCE TO CHRONIC RADIATION. Arnold H. Sparrow and Jerome P. Miksche (Brookhaven National Lab., Upton, N. Y.). Science, 134: 282-3(July 28, 1961).

Investigations show that, for diploid species, the larger the nuclear volume, the more radiosensitive the organism. Correspondingly, species with large nuclei have more deoxyribonucleic acid (DNA) per nucleus than those possessing small nuclei. It is possible to predict fairly accurately the tolerance of plant species to ionizing radiation on the basis of average nuclear volume and DNA content. The same correlations are expected to hold for some microorganisms and for animals and may explain differences in sensitivities of different cell types in many living organisms. (auth)

24711 RADIATION-CONDITIONED EARLY ALTERATIONS IN CELL NUCLEAR PROTEINS. I. HISTONE AND NUCLEAR GLOBULIN OF THE THYMUS AND SPLEEN. Hanna Ernst (Heiligenberg-Instituts, Heiligenberg/Baden, Ger.). Z. Naturforsch., 16b: 329-33(May 1961). (In German)

From sucrose-isolated cell nuclei of spleen and thymus of irradiated rats (1000 r), the globulin albumin fraction was extracted with 0.14 M NaCl and the histone with 0.2 N HCl. The concentration of these nuclear proteins was analyzed during the first day after irradiation. An immediate radio-induced protein loss, which comprises after 1 hr half the globulin and a fourth of the histone fraction, was observed. In the following 1 to 2 hr the protein level is almost completely normalized. Over the next 20 hrs a considerable uniform continuous protein synthesis set in. Only the globulin-albumin fraction of the spleen participates in the second phase of the protein loss. In the first 6 hrs after irradiation the DNS content of the tissues investigated is unaltered but then rapidly decreases. A relation between DNS and histone synthesis is very doubtful. (tr-auth)

24712 SOME ASPECTS OF THE EFFECTS OF IONIZING RADIATION ON CELLULAR METABOLISM. J. A. Cohen. p.141-9 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Available data are reviewed on the effects of low-level ionizing radiation on cells in tissue culture. It is concluded that a disturbance of the late stages of desoxyribonucleic acid synthesis is involved in radiation effects on cell viability, mitosis, and mutation. 70 references. (C.H.)

24713 A CYTOCHEMICAL AND AUTORADIOGRAPHIC STUDY OF THE EFFECTS OF IRRADIATION ON DEOXYRIBONUCLEIC ACID SYNTHESIS IN REGENERATING LIVER. William B. Lonney (Univ. of Cambridge, Eng.). p.163-89 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Results are reviewed from a series of cytochemical and radioautographic studies in which tritiated thymidine was used to trace the effects of radiation on the synthesis of desoxyribonucleic acid in regenerating liver of rats. The results suggest that the immediate effects are the result of formation inhibition. It is concluded that radiation affects the biosynthesis process of desoxyribonucleic acid replication. 49 references. (C.H.)

24714 RADIOSENSITIZATION BY OXYGEN AND CHEMICALS. J. S. Mitchell (Addenbrooke's Hospital, Cambridge, Eng.). p.647-60 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Attempts to improve the results of radiotherapy of malignant tumors by combining radiation with various chemical and physical agents are discussed. Results are reviewed for oxygen, nitrous oxide, prophyrins, urethane derivatives, chloroform, ethyl ether, saturated hydrocarbons such as pentane, sulfhydryl compounds, iodo-acetic acid, various dyes, fluorescent compounds, hormones, thyroxine, vitamins, aneurine diphosphate, lactoflavin-s-phosphate, adenosine triphosphate, Synkavite, adenosine, aneurine monophosphate, and other miscellaneous compounds. Synkavite, or tetra-sodium 2-methyl-1:4-naphthohydroquinone diphosphate administered intravenously appeared to be the best therapeutic radiosensitizer tested of 152 compounds and 98 combinations of compounds tested. (C.H.)

24715 RADIOSENSITIVITY OF MALIGNANT TUMOURS. A. Glucksmann (Strangeways Research Lab., Cambridge, Eng.). p.660-9 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

The relation between radiosensitivity and radiocurability of malignant tumors is discussed within the framework of two hypotheses on tumor radiosensitivity. One hypothesis is that the inherent differences in radiosensitivity of normal tissues are passed on to some extent to the tumors derived from them. The second hypothesis states that the curability varies with the number of tumor cells for a given radiation dosage. Quantitative considerations explain the greater radiocurability of differentiated as compared with anaplastic tumors and of small as compared with large carcinomas. The mechanism of sterilization of tumor cells by radiation is then examined to explain why some differentiating tumors are refractory and some anaplastic tumors are amenable to treatment. This analysis shows that the local radiocurability of tumors is determined by four factors: (1) the type of cell and its reproductive turnover, (2) the functional capacity of cells for differentiation under irradiation, (3) the number of tumor cells relative to radiation dosage, and (4) local and systematic factors affecting the growth and response of tumor cells. It is concluded that the radiosensitivity of malignant tumors is not only a quantitative and qualitative property of the cancer itself but is also determined by the interaction between the tumor and the host. (J.S.R.)

24716 RADIOBIOLOGY OF THE SENSITIVITY OF NORMAL TISSUE AND TUMORS TO PENETRATING RADIATION. J. Maisin, E. van Duyse, A. Dunjic, J. van de Merckt, and D. Werbrouck. p.669-85 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In French)

A survey is made of the latest data on the radiobiology of living tissues. The available data suggest an indirect effect of penetrating radiation by the intermediary of the formation of free radicals and the excitation of molecules. A sensitization of living tissues to the effect of toxic factors formed during irradiation is shown. The radiolesions which appear at the level of the most radiosensitive endocellular organites are the result of a chain of biochemical events. Various data suggest that the initial radiolesions can be an alteration of a nucleotide amine acid complex. Radiolesions are reparable up to a certain point. It was shown that for very low

radiation levels living organisms can adapt themselves to the effect of penetrating radiations. The thresholds for cancerization by penetrating radiation vary from organ to to organ. Cells of malignant tumors react to radiation according to basic laws just as normal cells do. 41 references. (J.S.R.)

24717 RADIOSENSITIVITY AND RADIOSENSITIZATION, ESPECIALLY OF TUMORS. Luigi Turano (Universität, Rome). p.689-98 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

After a classification of malignant tumors according to their radiosensitivity, factors affecting this sensitivity are analyzed by a consideration of lung cancers which are very radioresistant. Research on the sensitization of the tumor cells to radiation is indicated. (J.S.R.)

24718 EXPERIMENTAL STUDY OF RADIOSENSITIVITY OF MALIGNANT TUMORS. Gerhard Schubert and Wolfgang Dittrich (Universitäts-Frauenklinik, Hamburg). p.698-704 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

In order to better understand the mechanism of the radiation effect, tumor cells of intraperitoneal mouse ascites carcinomas were irradiated in vivo, and the effect of oxygen supply on the radioeffects was determined. The frequency of chromosome fragments was used as an indication of the sensitivity. Epilation and pigment loss after irradiation under various O_2 partial pressures were also studied. The results show that the physical-chemical state of the individual cell constituents—the medium in the broadest sense—at the time of the irradiation can greatly affect the radiosensitivity of biological objects. (J.S.R.)

24719 RADIOSENSITIVITY OF BRAIN TUMORS AND THE SO-CALLED RADIATION LATE NECROSIS OF THE BRAIN. K. J. Zülch (Max-Planck-Institut für Hirnforschung, Cologne-Merheim, Ger.). p.704-21 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

One method for evaluating the effectiveness of ionizing radiation on human brain tumors consists of a morphological study of individual cases for which the biological course can be reconstructed. Before giving the results of some of the case histories, the methodic difficulties in the determination of the radiation effect on brain tumors are indicated. The possibilities of malignization by irradiation and of massive radiation late necrosis in neighboring brain tissue are investigated. The question of whether the appearance of radiation late necrosis is automatic is reviewed. Studies show that radiation necrosis can be space limited. The treatment of brain tumors—by surgery, radiotherapy, or both—is indicated for given conditions. (J.S.R.)

24720 THE EFFECT OF TOTAL BODY IRRADIATION ON H^3-THYMIDINE INCORPORATION INTO DNA OF RAT BONE MARROW CELLS. T. M. Fliedner (Univ. of Heidelberg, Ger.), V. P. Bond, and E. P. Cronkite. p.922-6 of "IXth International Congress of Radiology, Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Total body irradiation of rats at dose levels of 550, 1000, and 1500 r causes severe damage to the vascular bed of the marrow with onset of edema and hemorrhage, the time of which is dose dependent. Autoradiographic studies of bone marrow sections and smears prepared 30 minutes after intravenous injection of tritiated thymidine at different times after irradiation provides a useful tool to study the proliferative potential of irradiated bone marrow cells. The finding can be explained on the basis of a) selective cell loss initially after irradiation, b) possible prolongation of DNA synthesis time by a slower rate of DNA synthesis, c) mitotic inhibition, the duration of which is dose dependent, d) formation of abnormal mitoses and interphase cells, which have altered proliferative potentials. (auth)

24721 ELEMENTARY MECHANISMS OF THE ACTION OF RADIATION. L. H. Gray. p.991-6 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

A review is given of probable mechanisms of the loss of reproductive integrity by mammalian cells. Particular reference is given to dose response relations for mammalian cells and the nature of the critical material and its response to radiation. Several previous works are cited. (P.C.H.)

24722 BIOLOGICALLY IMPORTANT RADIATION EFFECTS AT THE MOLECULAR LEVEL. Peter Alexander (Royal Cancer Hospital, London). p.996-1007 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

The biological changes produced by ionizing radiations are the result of metabolism developing an initial chemical effect which by itself does not give rise to a detectable lesion. The nature of this primary chemical effect is unknown, but it must be produced more effectively by densely ionizing (e.g., α rays) than by sparsely ionizing radiations as this is the order found in cells. This limitation excludes inactivation of enzymes and other biologically active macromolecules since these are altered most effectively by sparsely ionizing radiations. The effect of radiation on DNA is complex and under different conditions cross-linking or main-chain breakdown can result. Although such changes are believed to be responsible for the growth inhibiting effects of radiomimetic chemicals (e.g., the nitrogen mustards), they are produced less effectively by α- than by x or γ rays, and it is difficult to see how they can be responsible for initiating cellular lesions. Evidence suggests that "direct action" (i.e., ionization occurring within the sensitive structure) is more important than "indirect action" (the attack by free radicals formed on the ionization of water). A synthesis of the "target theory" and the "indirect action theory" is now possible. In the target theory, "direct action" is the principle source of damage, but the process is qualitatively akin to "indirect action" since it can be modified by external factors. The initial effect consists of breaking down barriers with the cell—a process requiring several ionizations simultaneously—and releasing enzymes to attack cell components from which they are normally shielded. (auth)

24723 BIOCHEMICAL ACTIONS OF IONIZING RADIATIONS. J. A. V. Butler (Royal Cancer Hospital, London). p.1007-1013 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Only effects which could have a marked influence on the life of the animal or on the functioning of some of its cells are considered. Types of cell systems considered are: enzymes dissolved in cell solutions as separate molecules; organized aggregations of enzymes such as exist in cell particles; and organized genetical systems composed of desoxyribonucleoprotein. Since the sensitivity of enzymes increases with dilution, the free path of a radical before recombination can be estimated from the enzyme concentration at which the sensitivity falls off. Observations on

chymotrypsin illustrate this. It was found unlikely, though, that any significant inactivation of free enzymes can be brought about by doses of the order of 1000 r, under conditions existing in living cells. In organized particles, such as mitochondria and microsomes, a different situation exists. A single ionization may cause a large degree of disruption of an aggregate containing many protein and other molecules. Regarding radiation effects of DNA, it was found that the extent of damage done to living cells by DNAase is uncertain. The radiosensitive stage in DNA synthesis of mammalian cells is yet unidentified. (P.C.H.)

24724 THE PROBLEM OF HIBERNATION IN RADIOBIOLOGY. G. G. Palmieri. p.1013-17 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

The studies made in Bologna on the effects of natural and artificial hibernation in animals on irradiation effects are briefly reviewed. The investigations on the problem of whether hibernation can offer radiation protection for humans are summarized. (J.S.R.)

24725 THE EFFECT OF IONIZING RADIATION ON PROTEINS, NUCLEIC ACIDS AND MICROSOMAL PARTICLES. Ernest Pollard (Yale Univ., New Haven). p.1018-22 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

With proteins and nucleic acids, effects can be measured and definite studies can be made. With microsomal particles this is not easily done since one must see the effect of radiation on the function. In the case of proteins radiation sensitivity is closely related to physical size. Ionization within the protein molecule will inactivate it, and in a wet cell, ionization within 20 Å may produce inactivation. Both ionization and the chemical action of radiation on water inactivate nucleic acids with great effect. The larger molecular size causes greater sensitivity. Protein synthesis is not concerned with the whole nucleus or with individual enzymes. The behavior of methionine vs. proline, histidine, etc., cannot be explained unless a 2 step process is involved. It is suggested that RNA or DNA molecules, acting as long threads, are part of the process. (P.C.H.)

24726 THE STRUCTURAL CHANGES IN ELEMENTARY BIOLOGICAL UNITS PRODUCED BY RADIATION. John D. Abbatt (General Electric Co., Ltd., Erith, Kent, Eng.). p.1022-6 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Genetic and somatic effects of radiation, the methods for studying genetics, and the importance of radiobiology are discussed. The necessity for controls in radiation studies is emphasized. (P.C.H.)

24727 KINETICS OF NEUTROPHIL BALANCE IN NORMAL AND IRRADIATED STATES. Harvey M. Patt and Mary A. Maloney (Argonne National Lab., Ill.). p.1027-35 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Radiation-induced perturbations of the neutrophil system against the background of the normal balance were investigated. The several parameters of neutrophil production, maturation, and utilization have been studied autoradiographically in dogs after administration of tritiated thymidine. Although comparable data have not yet been obtained for irradiated animals, the estimates of normal neutrophil turnover and ancillary studies of the neutrophil system provide further insight to the nature of the defects and their relationship to the totality of neutrophil balance. Thus, it has been shown that the neutrophil blood level may be buffered for several days after irradiation by cells in the developing marrow pool, and that normal stabilizing mechanisms may play an important role in marrow recovery. (auth)

24728 RADIOSENSITIVITY AND MECHANISM OF ENZYME SYNTHESIS IN BACTERIA. Helmut Pauly (Max-Planck-Institut für Biophysik, Frankfurt am Main). p.1035-8 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

The effect of x radiation and chemical inhibitors on the induction of lysine decarboxylase in Bacterium cadaveris was studied. The enzyme synthesis was followed by the decarboxylation of l-lysine. X radiation causes a decrease both in the induction rate and the final activity and by an equal factor. The curves for the dose dependence of the induction rate and the final activity are parallel and are approximated by an exponential function. The hypothesis that in each bacterium there is one or more synthetic centers of which each synthesizes only a given number of enzymatic molecules was supported by research with chemical inhibitors. (J.S.R.)

24729 MODIFICATION OF RADIOSENSITIVITY BY OXYGEN, NARCOTIC GASES AND INERT GASES. M. Ebert (Hammersmith Hospital, London) and Alma Howard. p.1039-43 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Events following the primary physical processes of energy deposition are discussed. The biradical character of O_2 possibly explains the rapid increase in radiosensitivity of biological materials when small concentrations of oxygen are present during irradiation. O_2 may act directly on a biological molecule which has been transformed to the radical R·, or it may act via some intermediate peroxy radical. NO, producing an action similar to that of O_2 except in systems irradiated in the dry state, enhances the radiosensitivity of several biological systems. The reaction of a free radical with NO produces stable molecules. Observations of free radicals in irradiated material were made using seeds of Agrostis stolonifera and NO. The inert gases, which protect by abolishing the close-enhancing effects of O_2, are the only protective agents whose actions cannot be explained by chemical mechanisms. Results show that the gases act independently, and their protective power is a property characteristic of the individual gas. These gases do exhibit anaesthetic potency. Studies of the physiological activity of these gases must be based on their physical rather than chemical properties. (P.C.H.)

24730 BEHAVIOUR OF SOME ENZYMATIC MECHANISMS UNDER THE EFFECT OF DIFFERENT IONIZING RADIATIONS, AND THEIR MODIFICATIONS AFTER TREATMENT WITH THE SO CALLED "PROTECTIVE" SUBSTANCES. Giuseppe Matli (Ospedale Maggiore, Turin) and Giovanni Rosso. p.1044-52 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

The mechanism of radiation effects and aspects of their study are discussed. Two groups of white mice were subjected to single massive doses of 180-kv radiation (800 r) and 31-Mev radiation (800 r). Results were obtained 22 to 24 days following the irradiations. From the content of pyridine-coenzymes in the liver, it was concluded that the content of hepatic nicotinamide in irradiated mice is slightly lower than in the non-irradiated mice. A study of

the intensity of hepatic biosynthesis of DPN following injections of nicotinamide (22 to 24 days after the irradiation) into the liver showed that the intensity is notably diminished in comparison to that in mice not irradiated. Cortisonic treatment does not counteract this action. (P.C.H.)

24731 EXPERIMENTAL AND CLINICAL STUDY OF THE INDIRECT RADIOBIOLOGICAL EFFECT. O. Costakel and S. Grigoresco. p.1052-7 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In French)

The numerous important theoretical and practical possibilities resulting from a profound study of the indirect radiobiological effect—not identical with the physicochemical effect—are reviewed in a summary of the principal results of a ten-year study of radiobiology. (J.S.R.)

24732 RADIATION EFFECTS ON CALCIUM METABOLISM BY BONES. A. Zuppinger and W. Minder. p.1058-60 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

The effect of x irradiation on Ca^{45} uptake in the tibia of adult rats was investigated. The easily exchangeable Ca component in bones shows a constant value 2 to 4 days after oral administration. After irradiation the Ca uptake first decreases rapidly, decreases slower after the first week, but then falls steadily to about $\frac{2}{3}$ normal in about 6 weeks. In the unirradiated extremity a brief indirect effect on the Ca uptake is detectable. The Ca uptake of the irradiated area falls rapidly with increased dose to a limiting value. This decrease can be satisfactorily represented by a simple exponential function. For 30-Mev electrons, the effect is so much lower that with consideration of equal energy uptake the relative biological effectiveness is $\simeq 0.6$. (tr-auth)

24733 ACTIVE ELECTROLYTE TRANSPORT AND RESPIRATION AFTER X IRRADIATION IN VITRO. H. K. Parchwitz and H. Breuer. p.1060-2 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

Electrolytic transport was studied in renal cortex sections irradiated with 14000 to 60000 r of x radiation in vitro. Increasing loss of potassium with dose was observed at an incubation temperature of 37°C. This loss was partially compensated by sodium uptake. The study of the effects of incubation temperature on the concentration gradient showed that the highest K and lowest Na values occur at 27°C. A consideration of the relationship between respiration as an energy source for the active transport and the electrolyte content showed no detectable effect of irradiation on the oxygen uptake by the section. After increase of the dose to 300,000 and 600,000 r there was a distinct increase in respiration. An increased potassium loss, again partially compensated by sodium uptake, was also observed. Possible mechanisms are indicated. (J.S.R.)

24734 CHANGE IN ERYTHROPOIESIS AFTER PELVIC RADIOTHERAPY. M. Tubiana, C. I. Bernard, C. Lalanne, and A. V. Belmonte. p.1063-4 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In French)

The functional depression of the erythropoietic system following irradiation is discussed. The modification produced by irradiation was studied first in order to test the functional activity of erythropoietic tissue. This included total and local metabolism of iron in irradiated and unirradiated regions. Nine subjects in which microscopic hemorrhage had not occurred and with whom all therapeutic material had been rejected were studied. Seven cases of epithelioma of the neck were found active, 2 patients had previously undergone an exeresis for tumors. An exploration for radioiron was made a week before the irradiation, then repeated about 2 months later, at the end of irradiation. (P.C.H.)

24735 THRESHOLD DOSE FOR THE LATE, LETHAL LIVER DAMAGE AFTER INTRAPERITONEAL INJECTION OF COLLOIDAL RADIOGOLD Au 198 IN MICE. J. Rygård (Radium Centre, Copenhagen). p.1064-9 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

The liver is the critical organ for lethal damage. Au^{198} was diluted to an activity of 11 mc per 0.01 ml with physiological saline and administered to mice in doses of 0.01 ml per g of body weight. Two days later the mice were killed and their livers examined. The liver uptake of radiogold injected intraperitoneally was 34% of the total and for those intravenously injected, 84%. A reduced mean survival time was found in mice injected intraperitoneally with 11 mc of colloidal Au^{198} per gram of body weight. True hepatomas on the nodules of the livers were not found nor was any true malignancy. If the latency period for liver damage manifestation is assumed to be the same as in man, then liver damage produced by Au^{198} would develop in such patients only after 15 years. (P.C.H.)

24736 EFFECTS OF IONIZING RADIATION ON THE COURSE AND OUTCOME OF PREGNANCY IN EXPERIMENTAL ANIMALS. N. Pobedinskii (Pobedinsky). p.1071-2 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

Whole-body single irradiations (300 r) of pregnant animals cause radiation sickness with pronounced leukopenia, alteration of the leukocyte formula, and anemia. The decreased hemoglobin content and erythrocyte count, which can be observed in unirradiated pregnant rats, are still lower in irradiated rats. However, an improvement of the red blood cell values begins earlier and procedes faster than is the case in non-irradiated animals. Blood formation of the pregnant animals was disturbed to a lower degree by the irradiation than that of non-pregnant animals. A regeneration of the bone marrow, especially the sites of blood cell formation, begins earlier in pregnant animals. The functioning of the hematopoietic organs was greatly reduced. It is to be assumed that the disturbance of blood formation in the embryonic development stage represents one of the principal origins of both prenatal and postnatal mortality of the young. (tr-auth)

24737 SOME OBSERVATIONS ON THE MECHANISM OF RECOVERY FROM RADIATION INJURY. Leon O. Jacobson, E. K. Marks, E. O. Gaston, and E. L. Simmons. p.1073-6 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Mice (CF No. 1 females) were transfused with washed red blood cells from the same strain. On the 7th day when the reticulocyte number had fallen to zero, the mice were exposed to 800 r of whole-body x radiation and 100 million rat bone marrow cells were given intravenously. Red cell transfusions were continued to maintain the hematocrit at ~70% to prevent red cell formation. The course of red cell formation was observed as the natural stimulus for erythropoiesis was restored. Tentatively it is concluded that physiologic suppression of erythropoiesis in polycythemic mice given lethal x irradiation and bone marrow transplants (1) does not interfere with the take of the transplant since

rat granulocytes appear at the expected time, and (2) that although erythropoiesis may be suppressed for at least 20 days, upon release of this suppression, the production of rat cells only, mouse cells only, or of both may begin. The data suggest that the heterologous transplant contains dormant erythroblasts capable of being activated, or that erythropoiesis may arise under these circumstances from a multipotential cell in the rat marrow transplant. (P.C.H.)

24738 MORPHOLOGICAL AND HISTOCHEMICAL STUDIES ON NORMAL AND ELECTRON IRRADIATED SKIN AND TUMORS. K.-H. Kärcher (Universität, Heidelberg, Ger.). p.1076-7 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

Histochemical investigations on normal and tumor tissues after irradiation with fast electrons are reported. The significance of the results for further clinical research is indicated. (tr-auth)

24739 LEUKOPENIA, NEUTROPENIA, AND BACTEREMIA IN MICE PROTECTED BY CYSTAMINE AFTER TWO SUCCESSIVE IRRADIATIONS BY X RAYS. D. J. Mewissen, E. H. Betz, M. Betz-Bareau, and G. A. Duchesne (Université, Liège). p.1078-81 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In French)

It has been shown that important variations in leukocytosis and neutrocytosis with respect to the bimodal monthly decrease of the mortality rate occur in irradiated mice. These phenomena were studied in irradiated mice protected with cystamine. Mice were exposed to two x irradiations for a total dose of 220 r. Bacteriological examinations, leukocyte counting, and determinations of leukocyte formulas were made at various times after irradiation. The results are graphed and tabulated. These results showed that the leukocyte drop is less and its rise is greater in animals protected with cystamine. Cystamine does not significantly affect the frequency of bacteremias. (J.S.R.)

24740 INCREASE OF RADIATION RESISTANCE BY CHEMICAL SUBSTANCES. Hans-Joachim Melching (Universität, Freiburg i. B.). p.1081-4 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

A brief survey is given of the radioprotective effects of some biogenic amines. The survival rates of white mice receiving 5-hydroxytryptophan, pyridoxal-5-phosphate, and adenosine triphosphoric acid alone and in combination are compared with the survival rates of mice receiving serotonin. The three substances in combination have a protective effect equivalent to the effect of serotonin. (J.S.R.)

24741 ON THE EFFECTS OF SOME CHEMICAL SUBSTANCES AND NUTRITIVE ELEMENTS AGAINST RADIATION INJURIES, ESPECIALLY ON THE USE FOR PATIENTS WITH MALIGNANT TUMORS. Hideo Irie (Kysuhu Univ., Fukuoka). p.1085-6 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

D-D strain male mice were used. Survival rates were studied in each experiment. In the first experiment, mice were divided into 3 groups and fed 70, 100, and 150% of a standard food after which they were irradiated in single dose. In the second, mice were grouped and fed on carbohydrate, animal protein, and animal fat. In the third experiment, mice were fed vitamins. In the fourth experiment, carcinoma was transplanted subcutaneously in mice and single doses of 700 r were given locally. Radiation effects were determined in all experiments. The results indicate that the administration of protective substances to cancer patients under radiation therapy to reduce systemic or local side effects does not interfere with the therapeutic effect. (P.C.H.)

24742 CHILDREN BORN OF IRRADIATED PARENTS (THE PARTICULAR CASE OF THE SEX RATIO). Jérome Lejeune, Raymond Turpin, and M. O. Rethoré. p.1089-95 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In French)

A decrease of the sex ratio in the descendants of mothers irradiated in the pelvic region and a slight increase of the sex ratio in descendants of irradiated fathers was found. These figures are somewhat flexible. Among the mothers, an extra pelvic irradiation (very weak dose/ovary) caused little or no effect on the sex ratio, but with a greater pelvic irradiation a slight decrease of the sex ratio resulted. Among the fathers, a relatively large pelvic irradiation (dose/testicle) can cause an increase in the sex ratio. However, an extra pelvic irradiation, a testicle dose of 2 to 20 r, causes a highly significant decrease of the sex ratio. Without wishing to affirm that the sex ratio may be an indicator of provoked mutations, it seems a legitimate indicator for man. (P.C.H.)

24743 NATURAL AND ARTIFICIAL RADIOSENSITIVITY OF HEREDITARY MATERIALS. Hedi Fritz-Niggli (Radiotherapeutische Klinik des Kantonsspitals, Zurich). p.1095-1102 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

For various mutation types (dominant, recessive, lethal factors, translocations, and chromosome-(fragment) loss) there is a dependence of the radioinduced mutation rate on the state of development of the germ cell. The large number of dominant lethal factors, which arise in the irradiated spermatozytes and spermatides (Drosophila), produces a pseudosterility. In irradiation in pure nitrogen, the radiosensitivity of various stages is homogeneous, the differences are cancelled. In addition to other interpretations, it was assumed that the changing physiological state of the germ cell is responsible for the different natural radiosensitivities of the hereditary material. The cytoclastic radioeffect complicates the interpretation of the genetic radioeffect. A model of the mutation reaction is given. (tr-auth)

24744 BIOLOGICAL INSTANTANEOUS REACTIONS TO WEAK RADIATION DOSES. O. Hug. p.1181-95 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

Recently, attention has turned to radiation biological instantaneous reactions. Doses of the order of 1 r and less are capable of changing temporarily the operational state of the central and vegetative nervous system and of producing motion reflexes in the lower animals. In mammals doses of 10 to 100 r can cause behavior alterations and reflex-type reactions of vegetative controlled organs. This quantitatively investigated effect shows a definite threshold value of the dose efficiency and over this value a characteristic dependence of the minimum dose on the dose efficiency. It is unlikely that such effects of small radiation doses depend on irreversible chemical changes of organic materials. From indications on the biophysics of the visual path and of the x-ray phantom it was supposed that not only specific molecular or cellular photoreceptors, but also other organic molecular and large areas of highly

ordered macromolecular structures, can be converted temporarily by ionization and excitations with or without interposition of free water radicals into an altered energy state which can produce immediate fleeting changes of physiological functions. Therefore reversible changes of the cell membrane and similarly synthesized intracellular organelles are hypothecated. Also extracellular macromolecular complexes such as mucopolysaccharide show characteristic reversible physical-chemical changes setting in immediately after irradiation with perturbation of the permeability of the connective tissue basic substance. Possibly the release of biogenic amines under irradiation can be traced back to similar mechanisms. Further insight into the processes which take place in living substances immediately during irradiation is to be expected from the latest methods of microscopy and also from an expansion of radiation chemistry by methods with which the kinetics of radio-induced or radio-affected reactions can be followed directly during and after irradiation. (tr-auth)

24745 LONG-TERM EFFECTS OF RADIATION. G. Failla and Patricia McClement Failla (Columbia Univ., New York). p.1195-1203 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

The effect of chronic irradiation on leukemia as a cause of death is investigated. In estimating the increase of leukemia incidence from exposure to radiation, it is assumed that there is no threshold and the dose-effect relation is linear. According to the mechanism given, the incidence of leukemia depends on the genetic system of the population (reflected by the spontaneous mutation rate) and on the environment. Any pertinent change in either may alter the incidence. Continuous whole-body exposure at a constant low dose rate may be considered to be approximately equivalent to an increase in the spontaneous mutation rate. It is not possible to suggest at this time a relation between dose rate of continuous irradiation and the incidence of leukemia in the exposed populations. (P.C.H.)

24746 SOMATIC EFFECTS OF RADIATION AT LOW LEVELS OF DOSAGE, WITH PARTICULAR REFERENCE TO PROTRACTION OF RADIATION EXPOSURE. L. F. Lamerton (Royal Cancer Hospital, London). p.1203-11 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

The response of the body to long continued irradiation at low dose rates is discussed. A general review is given first. Some experimental work on continuous, high-dose-rate irradiation of the epithelium of the small intestine and the blood forming tissues in mice and approximate survival times is reported. For whole-body irradiation below 600 rads, the major cause of death is hematopoietic failure. Above 600 rads most deaths result from intestinal failure occurring within a short time of irradiation. The main difference in behavior between blood forming tissues and gut is not discussed in detail except to say that it depends very much on the action of the spleen. Present investigations are being made of the response of continuously irradiated intestine to a single dose of radiation to determine whether its basic radiosensitivity has changed. (P.C.H.)

24747 RADIATION HAZARDS DURING EMBRYONIC DEVELOPMENT. Liane Brauch Russell (Oak Ridge National Lab., Tenn.). p.1212-19 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

A general survey rather than the most recent data is presented. Practical questions of interest to the medical profession are answered. Over 10 years ago, experiments were started as a systematic survey of the entire gestation period of the mouse. Irradiation of groups of embryos differing by 24 hours of age and ranging from half-a-day post-fertilization to almost full-term, revealed a close correlation between stage of development and radiation effect. Concerning hazards to the human embryo, threshold doses for the induction of several anomalies were demonstrated and no straight-line relation between dose and embryonic anomalies, taken as a whole, were found. (P.C.H.)

24748 RADIATION LEUKAEMOGENESIS IN MAN. W. M. Court Brown (Radiation Western General Hospital, Edinburgh). p.1219-22 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

The problem of radiation-induced cancer in man is discussed. There have been 2 phases of development thus far. The first phase commencing with the first published case of a cancer in 1902, and the second and present phase being dated from published information in 1952 on the mortality from leukemia among the atomic bomb survivors. Both phases and the paths along which such studies may develop are discussed. (P.C.H.)

24749 ON THE RELATION OF RADIATION LETHALITY TO RADIATION INJURY, AND ITS RELEVANCE FOR THE PREDICTION PROBLEM. George A. Sacher (Argonne National Lab., Ill.). p.1223-32 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Assuming homology is established, several approaches are discussed that attempt to make a quantitative estimate of effects in one species in terms of observations in another. Mathematical equations were found to be inadequate for quantitatively describing the lethal injury process. This process is composite, depending on the parameters of several different physiological systems. However, it is possible to describe the probabilistic actuarial effects of radiations and aging by simple mathematical relationships, if the probabilities are subjected to the Gompertz transform. The fundamental hypothesis in explaining this is: the logarithm of the rate of mortality (Gompertz transform) is the appropriate quantity for discussing aging and chronic radiation effect in mammals because it stands in approximately linear relation to the physiological injury. Some examples are mentioned. (P.C.H.)

24750 THE EFFECT OF CHRONIC LOW LEVELS OF RADIATION IN MAN: THE CONTRIBUTION OF EPIDEMIOLOGICAL STUDIES. L. D. Marinelli (Argonne National Lab., Ill.). p.1234-8 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Three populations are discussed: those treated with I^{131}, those burdened with Ra^{226}, and those injected with Thorotrast. In the treatment of hyperthyroidism with I^{131} proper controls are essential. Studies were made of normal populations receiving whole-body irradiation at levels within 10 times background (0.1 to 1.0 rem per year). Approximately 4% of the population of Illinois lives in communities supplied with potable waters containing, on the average, Ra^{226} and Ra^{228} in excess of 4 $\mu\mu c/l$. The dose-rate in persons of the Ra^{226} group is spotty and timewise diminishing, but the dose-rate in the Thorotrast group is uniform and relatively constant. Estimated doses to various organs and tissues are given. (P.C.H.)

24751 LIFE SPAN AMONG HEAVILY IRRADIATED WOMEN. R. R. Newell. p.1238-41 of "IXth International

Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

The average age of the patients when irradiated was over 50; the average predicted lifetime was 75. Whether the effect of irradiation may be separated from the effect of cancer was a major question. Instead of following the aggregate lifetime as reduced by all causes from year to year, the accumulated losses to cancer and other diseases and the gains among the survivors as they grow older were followed separately. The mortality of 217 women was followed for 10 years or longer after being cured of cancer by irradiation. No shortening of life-span was apparent, whether the integral dose was 5 or more than 30 megagram rads. (P.C.H.)

Radiation Sickness

24752 (AERE-R-3728) SOME RADIATION SYNDROMES AND TREATMENT. Katharine Williams (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1961. 27p.

An account is given of some short-term high-level radiation exposures to man in various accidents, the radiation syndromes arising therefrom, and the factors modifying the clinical effects. Biological and clinical indicators of radiation dosage and criteria of radiation injury are considered. Replacement therapy and general management of irradiated patients are discussed. (auth)

24753 (JPRS-9420) THE REACTION OF THE ISLET APPARATUS OF THE PANCREAS DURING THE RADIATION SYNDROME. V. V. Tsvetkova. Translated from Fiziol. Zhur., Akad. Nauk Ukr. S.S.R., 7: No. 1, 76-81 (1961). 8p.

White rats of a modified Azan strain were irradiated with x rays at a total dose of 500 r. The experimental animals were autopsied 2, 12, 24 hours, and 2, 4, 7, 10, 15, 20, and 30 days after irradiation for blood-sugar level, relative area of the islet tissue, the differentiation of the cellular structures by the Azan and Gomori methods, and the relative proportions of A and B cells. Excess blood sugar was found on the second day; the tenth day found the blood-sugar level near normal; the excess developed again and reached a peak on the 30th day. The B-cells showed signs of functional exhaustion, while the A-cells showed marked qualitative changes; there were signs of a reduction in the relative numbers of both types. Changes in the blood-sugar level occurred simultaneously with corresponding disturbances in the activity of the insulin-producing tissue of the pancreas. (B.O.G.)

24754 (JPRS-9421) CHANGES IN PROTEIN FRACTIONS OF THE BLOOD SERUM OF DOGS IN ACUTE RADIATION SICKNESS. E. (Ye.) Yu. Chebotar'ov. Translated from Fiziol. Zhur. Akad. Nauk Ukr. R.S.R., 7: No. 1, 83-91 (1961). 13p.

Results of studies on the composition of the protein fractions of the blood serum in dogs during acute radiation sickness led to the conclusion that similar studies may be used in diagnosis. Changes in the composition of serum proteins corresponded to the clinical course. The appearance of α- and β-globulin sub-fractions was regarded as an unfavorable prognostic sign. (C.H.)

24755 (JPRS-9422) CHANGES IN THE PROPERTIES OF MONKEY BLOOD PLASMA WHICH ARE TOXIC FOR PARAMECIA IN ACUTE RADIATION SICKNESS. G. A. K. Dzhafarov. Translated from Fiziol. Zhur. Akad. Nauk Ukr. R.S.R., 7: No. 1, 93-9(1961). 11p.

Blood plasma from irradiated monkeys had a toxic effect on paramecium. The toxic properties increased steadily during the period 3-hrs post irradiation. The toxic properties also increased with radiation dose. Data are tabulated. (C.H.)

24756 (JPRS-9633) THE EFFECT OF SOME COMPLEX COMPOUNDS OF COBALT SALTS WITH VITAMINS OF THE B GROUP UPON THE PERIPHERAL BLOOD IN EXPERIMENTAL RADIATION SICKNESS. M. F. Runova. Translated from Farmakol. i Toksikol., 24: 191-6(Mar.-Apr. 1961). 20p.

Complex compounds of cobalt iodide with novocain, nicotinamide with the chloride salt of bivalent cobalt, and compounds of vitamin B_1 with cobalt all gave good results in the treatment of the symptoms of radiation sickness in rats. A less marked effect upon the blood picture was obtained with a complex compound of cobalt with vitamin B_6. Compounds of cobalt with para-aminobenzoic acid and cobalt with folic acid had no effect on the blood chemistry. (C.H.)

24757 (JPRS-9649) EXPERIMENTAL HEMATOLOGICAL RESEARCH ON IRRADIATED RATS TREATED WITH HOMOLOGOUS BONE MARROW. V. Apateanu, S. Nicoara, and Gh. Grigoriu. Translated from Med. interna, 13: No. 1, 97-104(Jan. 1961). 12p.

A survival of 60% of lethally irradiated rats was obtained by homologous bone marrow grafts as compared to 34% survival in controls. The protection afforded by bone marrow was determined to be in direct proportion with the injected cells, the route of administration, and the source of the grafted material. Hematologic regeneration was faster in the grafted rat and immunologic reactions of the irradiated rats were markedly diminished for a period immediately following graft and irradiation. (C.H.)

24758 (T-345R) CHANGES IN WATER-SALT EXCHANGE IN RADIOPHOSPHORUS INDUCED RADIATION SICKNESS IN RABBITS. M. A. Khvoinickaya. Translated by E. R. Hope from Med. Radiol., 4: No. 4, 88-90(1959). 5p.

Radioactive phosphorus was injected subcutaneously into rabbits in the form of an aqueous solution of sodium diphosphate. After injection, a vigorously developing leukopenia was noted in the peripheral blood. During the first one or two days after the P^{32} injection, an increased elimination of water in the urine with no change of water intake was observed. During the following few days urination fell below the original figures, after which it again gradually increased and reached a maximum 3 to 5 days before the death of the animals. During the last days of life, diuresis sharply decreased. There was a 0.5 to 8.5% increase of water in the whole blood during the radiation sickness. The content of chlorides in the blood plasma and of calcium in the blood serum fell to amounts below the initial levels. There was noted a tendency for the amount of chlorides in the urine to decrease as compared with initial levels. (M.C.G.)

24759 RADIO-PROTECTIVE EFFECT OF A FALL IN BODY TEMPERATURE AS A RESULT OF THE ENSUING HYPOXIA. M. M. Konstantinova (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 223-6(May 1, 1961). (In Russian)

Mice with a normal body temperature (36 to 37°C), and mice whose body temperature had been lowered to 18, 12, and 6°C by immersion in an ice bath, were irradiated with a lethal dose of 900 r. The oxygen pressure in the liver and spleen was measured polarographically in parallel on

other mice. At a temperature of 15 to 18°C the oxygen tension in the liver and spleen fell to 50% of its initial value, and at a temperature of 6°C, the drop amounted to 90% of its initial value. A decrease in body temperature to 18°C resulted in a 10% survival compared to 100% mortality in irradiated mice whose body temperature was normal (36 to 37°C). The survival increased to 16% at a temperature of 12%C, and to 36% at a temperature of 6°C. The survival of the mice increased with the degree of hypoxia which in turn depended on the degree of hypothermia induced in the mice. A significant protective effect is observed only on lowering the oxygen tension in the tissues by more than 50%. The survival is adversely affected by a decrease in body temperature by itself, since it takes 10 to 12 hours to restore normal body temperature after cooling. (TTT)

24760 PATHOPHYSIOLOGICAN AND CLINICAL ASSESSMENT OF CHANGES OF ERYTHROCYTE RESISTANCE TO SAPONIN IN THE PROCESS OF ROENTGEN THERAPY. A. A. Krylov (Kirov Therapy Hospital for Military Medicine, USSR). Med. Radiol., 6: No. 4, 19-24 (Apr. 1961). (In Russian)

In 40 patients undergoing roentgen therapy dynamic studies were made concerning the resistance of erythrocytes to saponin. A method of kinelysis was employed with a Soviet photoelectric colorimeter FEK-M. In the majority of patients subject to deep roentgen therapy there was noted a considerable rise of erythrocyte resistance to saponin, which is considered as a manifestation of compensatory mechanisms. A rapid decline of the resistance ("saponin disruption") was preceded, as a rule, by radiation toxemia and served as a signal of the necessity of repeated blood transfusions. The technique referred to is recommended as an objective index of the state of regulatory mechanisms in the process of irradiation. (auth)

24761 CHANGES OF THE ARTERIAL PRESSURE IN RABBITS DEPENDING UPON THE IRRADIATION DOSE. A. N. Lanin (Central Scientific Research Inst. for Radiological Medicine, Ministry of Public Health, USSR). Med. Radiol., 6: No. 4, 24-9(Apr. 1961). (In Russian)

Studies were conducted pertaining to changes of the arterial pressure depending upon the dose of x-ray irradiation. The degree of arterial pressure decline prior to the animal's death is in proportion with the dose of irradiation. (auth)

24762 PATHOMORPHOLOGICAL CHANGES OF THE SKIN IN CHRONIC RADIATION SICKNESS. N. N. Garvei (State Scientific Research Inst. for Roentgenology and Radiology, Ministry of Public Health, USSR). Med. Radiol., 6: No. 4, 29-33(Apr. 1961). (In Russian)

Studies were made of the structural injuries occurring in the various skin elements during chronic radiation sickness. The degree of changes of various elements of the skin corresponded to the degree of injury of its nerve apparatus. (auth)

24763 THE STATE OF THE LYMPHATIC PATHS DURING THE ACTION OF IONIZING RADIATION ACCORDING TO DATA OF INTRAVITAL LYMPHOGRAPHY. Ya. B. Mittel'berg (Kazan State Scientific Research Inst. for Traumatology and Orthopedics, Ministry of Public Health, USSR). Med. Radiol., 6: No. 4, 33-6(Apr. 1961). (In Russian)

Information is given concerning the condition of the lymphatic paths during the acute action of ionizing radiation in accordance with data of intravital lymphography. (auth)

24764 THE ROLE OF HYPOTHERMIA CAUSED BY SOME SUBSTANCES IN THE MECHANISM OF THEIR RADIOPROTECTIVE ACTION. P. G. Zherebchenko, I. G. Krasnykh, and V. S. Shashkov. Med. Radiol., 6: No. 4, 37-40(Apr. 1961). (In Russian)

Investigations are reported pertaining to the relation between hypothermia caused by pharmacological substances and their radioprotective effect. A complete correlation has been established between the time of development of deep hypothermia and the optimal term of manifestation of the radioprotective action of reserpine and phemerasole. A conclusion is made to the effect that deep hypothermia caused by some pharmacological substances may play a prominent role in the mechanism of their radioprotective action. (auth)

24765 DISTURBED DETOXICATION OF THE ORGANISM IN RADIATION SICKNESS. P. N. Kiselev, V. N. Sivertseva, and K. I. Nikitina (Central Scientific Research Inst. for Medical Radiology, Ministry of Public Health, USSR). Med. Radiol., 6: No. 4, 41-8(Apr. 1961). (In Russian)

For the analysis of causes of elevated sensitivity of the irradiated organism to bacterial toxins and weakening of the preventive effect of antitoxins in radiation sickness, studies were made of the quantitative content of the diphtheritic toxin in the blood and organs of control and irradiated (500 r) white rats upon its intravenous administration. Disturbance of processes of natural detoxication in radiation sickness is the cause of elevated sensitivity to bacterial toxins and weakening of the preventive action of antitoxins in the irradiated organism. (auth)

24766 DISTURBANCES IN THE WOUND PROCESS AFTER TOTAL X-IRRADIATION. R. G. Tsanev, G. G. Markov, and A. S. Khristova (Inst. of Biology, Bulgarian Academy of Science, Sofia). Med. Radiol., 6: No. 4, 48-55 (Apr. 1961). (In Russian)

Various components of the wound process are endowed with a different radiosensitivity. After total irradiation the most inhibited is the leukocytic infiltrate formation, the least inhibited is the granulation tissue development, whereby the most resistant proved to be the epidermis regeneration. The course of the wound process in the irradiated organism depends on the nature of the wound: the presence or absence of necroses and infection. In all cases the wound process in the irradiated animals runs a more severe course when the wounds are inflicted during the clinically marked radiation sickness. (auth)

24767 AN ELECTROPHYSIOLOGICAL ANALYSIS OF CERTAIN ASPECTS PERTINENT TO THE INTERRELATION OF RADIATION EFFECTS AND CHEMICAL PROTECTION. A. M. Stashkov (Inst. for Experimental Medicine, Academy of Medical Science, USSR). Med. Radiol., 6: No. 4, 63-9(Apr. 1961). (In Russian)

In preliminary administration of β-mercaptoethylamine and β-mercaptopropylamine there occurs prevention and compensation of functional disturbances associated with the phasic development of pathological rhythm depression in the central nervous system and particularly in its subcortical sections (hypothalamus). It could be assumed that this mechanism is of decisive importance in the survival of animals. (auth)

24768 THE CURVES OF BINDING OF OXYGEN AND CARBON DIOXIDE BY THE BLOOD IN DOGS AFFECTED WITH Po^{210}. G. I. Bezin. Med. Radiol., 6: No. 4, 69-72 (Apr. 1961). (In Russian)

Subject to investigation was the respiratory function of

the blood during the dynamics of radiation sickness in dogs affected with Po^{210} (0.05 mc/kg subcutaneously). The dynamics of changes of oxygen partial pressure in the arterial and venous blood and of the circulation rate pointed to the development of hypoxia of the circulatory type. (auth)

24769 EXPERIMENTAL STUDIES ON THE PROTECTIVE EFFECT OF SEVERAL PHARMACOLOGICAL AGENTS AGAINST X-IRRADIATION. Yozo Shakudo (Osaka City Univ.). Ôsaka Shiritsu Diagaku Igaku Zasshi, 9: No. 10, Suppl. 3, 3771-91(Oct. 1960). (In Japanese)

The protective effects of several pharmacological agents against lethal radiation effects were tested in mice. Noradrenaline, phenylephrine, naphazoline, tetrahydrozoline, and methoxamine markedly reduced radiation mortality when injected 5 min before exposure. Adrenaline and phenylethylamine had little protective effect, while ephedrine had no effect. Cocain was moderately effective, while caffein had little effect. (C.H.)

24770 THE PROBLEM OF CHEMICAL PROTECTION AGAINST IONIZING RADIATION. N. P. Buu-Hoi (Université, Paris). p.149-56 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

The types of damage produced by various radiations are briefly reviewed as an introduction to chemical protection against radiation. Studies on amines, thiols, and substances opposing self-oxidation as radiation protectors are then summarized. (J.S.R.)

24771 BIOLOGICAL PROTECTION AGAINST RADIATION THROUGH BONE MARROW TRANSPLANTATION. Leonard J. Cole (U. S. Naval Radiological Defense Lab., San Francisco). p.156-62 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Factors involved in protection of mice against radiation injuries by non-isologous bone marrow injections are discussed. Factors considered include radiation dose, antigenic difference between marrow donor and host, number of bone marrow cells injected, number of immunologically reactive cells in the injected marrow, and prior sensitization or immunization of the host to antigens. (C.H.)

24772 THERAPY AFTER WHOLE-BODY IRRADIATION WITH LARGE DOSES. H. Jammet. p.1275-9 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In French)

A brief survey is made of therapy for persons receiving massive doses of whole-body irradiation. Hematopoietic transplants for persons receiving more than 500 rems are reviewed. The prognosis for various exposure levels is described. (J.S.R.)

CHEMISTRY

General and Miscellaneous

24773 (AD-250745) OPTICAL PROPERTIES OF ANODIC OXIDE FILMS ON TANTALUM, NIOBIUM AND TANTALUM + NIOBIUM ALLOYS, AND THE OPTICAL CONSTANTS OF TANTALUM. Quarterly Report No. 16 for Period July 1 to September 30, 1960 on THE FORMATION OF OXIDE FILMS ON METALS. L. Young (British Columbia Research Council, Vancouver). Contract PE 69-900100. 30p.

The refractive indices of oxide films formed on Ta, Ta–75 at % Nb, Ta–25 at % Nb, and Nb were calculated from reflectivity measurements. The results indicate that the oxide films contain thin outer layers of light-absorbing oxide and that their refractive indices depend on the way the films are formed, e.g., in dilute or concentrated solution. Preliminary measurements on Zr are reported. (D.L.C.)

24774 (AFCRL-5) RECOMBINATION KINETICS FOR THERMALLY DISSOCIATED Li–B ION PAIRS IN Si. Scientific Report No. 5. E. M. Pell and F. S. Ham (General Electric Co. Research Lab., Schenectady, N. Y.). Dec. 14, 1960. Contract AF19(604)-5551. 44p. (AD-249825)

The kinetics of a diffusion limited pairing reaction between oppositely charged impurity ions in a solid were studied by observing the capture of mobile Li^+ ions by B^- ions in Si. The kinetics were determined by measuring resistivity as a function of time after the method of Reiss, Fuller, and Morin. As pairing proceeds, the resistivity decreases because of the disappearance of the charged impurity scattering associated with unpaired ions. Measurements were made between 2°C and 35°C. The observed kinetics are not of first order and are best described by a model in which pairing is largely a random process with little correlation between particular Li^+ and B^- ions. Diffusion constants of Li^+ calculated from the kinetics are in accord with previous ion drift results. (auth)

24775 (GA-1896) CHEMISTRY OF URANIUM–OXYGEN SYSTEMS. Final Report. C. F. Miller, Ulrich Merten, and J. T. Porter (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Jan. 13, 1961. Contract AT(04-3)-167. 65p.

X-ray investigations of U–O–Nb compositions equilibrated at 1100°C reveal a complex phase system which can be partially rationalized on the basis of the U–O and Nb–O systems. An independent analysis of the literature data on nonstoichiometric behavior in the U–O system is presented, with a resulting improved analytical description of portions of the system. Theoretical considerations of the alkali metal–uranium–oxygen systems are presented which suggest certain experimental investigations. Preliminary work on such investigations is reported. (auth)

24776 (IA-608) ANION EXCHANGE OF METAL COMPLEXES. VII. THE LANTHANIDES–NITRATE SYSTEM. Y. Marcus and I. Abrahamer (Israel. Atomic Energy Commission, Tel-Aviv). May 1961. 31p.

Previous results for the distribution of the lighter lanthanides between nitrate solutions and a strongly basic anion exchanger were extended by data for the heavier lanthanides. An odd-even Z effect, previously observed in solvent extraction studies, was also found in this work. The extraction of the lanthanides by a long chain amine is described briefly. The results are interpreted in terms of nitrate complex formation and changes in the hydration of the lanthanides in nitrate solutions. (auth)

24777 (NAA-SR-6331) THE OXIDATION OF "REACTIVE" URANIUM CARBIDE. E. W. Murbach (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 15, 1961. Contract AT(11-1)-GEN-8. 15p.

The oxidation of uranium carbide by oxygen, air, and water vapor, was investigated at temperatures up to 600°C. Arc melted and cast uranium carbide displayed oxidation behavior that appeared to be dependent on its pre-test history. "Reactive" uranium carbide ignited in oxygen at about 275°C, and in air at about 350°C. The product of the initial oxidation appeared to be UO_{2+x}. Continued heating produced U_3O_8. The activation energy determined for the initial oxidation reaction was 7.1 kcal, from 400 to 600°C in 10 mm of oxygen. (auth)

24778 (NP-9537) RESEARCH AND DEVELOPMENT OF HIGH TEMPERATURE STABLE ORGANO-PHOSPHORUS COMPOUNDS. Quarterly Progress Report No. 2, August 1, 1960 to November 1, 1960. Charles F. Baranauckas, Richard D. Carlson, Edward E. Harris, and Robert J. Lisanke (Hooker Chemical Corp., [Niagara Falls], N. Y.). Nov. 15, 1960. Contract AF 33(616)-7191. 63p.

Preparation and identification were completed on two series of bis-phosphines and bis-phosphine oxides. The uses of the cleavage mixture from the action of lithium metal on triphenyl phosphine were repeated on a larger scale on methylene, ethylene, and phenylene dihalides. The reaction of alkyl dihalides with diphenyl sodium phosphides was investigated. The preparation of bis-phosphine oxides by decomposition of quaternary phosphonium salts is described. Products from the reaction of diphenyl phosphinic chloride with the di-Grignard reagent produced from polymethylene dibromide and magnesium were investigated. Infrared spectra are given for the compounds prepared. (M.C.G.)

24779 (NYO-9580) ULTRASONIC DISSOLUTION OF ALUMINA AND OF HIGH-FIRED THORIA PELLETS. William B. Tarpley and Robert S. Winchester (Aeroprojects, Inc., West Chester, Penna.). Apr. 1961. Contract AT(30-1)-1836. 23p.

Ultrasonic energy was applied to the dissolution of thoria pellets (96% ThO_2–4% UO_2, fired in reducing atmosphere to 93% of theoretical density) in refluxing 13 M HNO_3–0.04 M NaF–0.1 M Al^{3+}. Substantial improvement in dissolution rates was achieved in each of three ultrasonic vessel geometries, resulting in 3- to 4-fold rate increases over nonultrasonic dissolution. Clear solutions resulted, indicating complete dissolution of the refractory particles, whereas parallel nonultrasonic controls gave solutions containing finely divided undissolved residue. Alumina crucible material, of interest in itself and as a simulant for oxides of actinide elements, was dissolved ultrasonically in refluxing 13 M HNO_3–0.04 M HF–0.06 M Al^{3+} within 50 hours, giving a clear solution. A nonultrasonic control, mechanically stirred under the same conditions, was only 9.4% dissolved. Corrosion testing and ultrasonic dissolution tests in Nionel and titanium vessels indicate that these are suitable materials for pilot plant ultrasonic dissolver equipment. (auth)

24780 (NYO-9694) INORGANIC ELECTROLYTES IN ANHYDROUS ACETONITRILE. Technical Report No. 6. George J. Janz and Arthur E. Marcinkowsky (Rensselaer

Polytechnic Inst., Troy, N. Y.). July 1961. Contract AT (30-1)-1999. 41p.

Paper prepared for a Symposium "Some Aspects of Electrochemistry" National Institute of Sciences of India, New Delhi, India, Oct. 6-7, 1961.

The properties of solutions of KI, $AgNO_3$, $CoCl_2$, and $CoBr_2$ in anhydrous acetonitrile were studied by means of measurements of electric conductance, density, viscosity, and spectrophotometry. The data are examined in the light of theoretical concepts of electrolytes. The properties of acetonitrile as an ionizing solvent are discussed briefly, and a summary of existing information for inorganic salts in this solvent is presented. (D.L.C.)

24781 (TID-13188) TERMINAL RESEARCH PROGRESS REPORT. W. B. Smith (Ohio Univ., Athens). 1960. 7p.

The role of hydrogen as a migrating group in the pinacol rearrangement was studied for 2-methoxy-2-methyl-3-butanol and 2-methoxy-2-methyl-3-butanol-3-d. The implications of the results for the mechanism of pinacol rearrangement are discussed. (D.L.C.)

24782 (TID-13222) THE ENTHALPY OF MIXING OF SOLID SOLUTIONS. THE BINARY SYSTEM TETRAMETHYLMETHANE–TETRACHLOROMETHANE. Edgar F. Westrum, Jr. and Elfreda Chang (Michigan. Univ., Ann Arbor). [1961]. Contract AT(11-1)-70. 22p.

The heat capacities of several samples of different compositions in the system $C(CH_3)_4-CCl_4$ were studied from 5 to above 300°K for information concerning the nature of the solid solutions formed by these components, both of which are composed of globular molecules and form plastic crystals. The complex thermal properties observed and the enthalpy of mixing are discussed. (auth)

24783 (TID-13301) PROGRESS REPORT [ON ALKALI HALIDES]. Technical Report Nos. 15-16. (Anderson Physical Lab., Champaign, Ill.). June 1961. Contract AT(11-1)-544. 33p.

The zone refining operation was reduced to a routine procedure. The boat breakage problem was solved by employing carbon boats. But this introduced a problem of colloidal carbon in the finished salt. This did not appear to effect the conductivity but it contaminated the salt. One effort to distill the salt away from the carbon resulted in failure but the still is being refined and other efforts are being made to separate the zone refined salt from the carbon. The conductivity apparatus was put in working order and checked with the results of other laboratories on samples of the same crystal. The normal cathode layer spectrochemical procedure was modified to use an argon protected arc. This eliminated the CN bands and gave much greater reproducibility. The sensitivity for most elements was such, however, that the method will be useful only for salts of ordinary purity. The gases in the salt are being analyzed by vacuum fusion apparatus. Its present state and some results on KBr are given. (auth)

24784 (WAPD-TM-204) THE BEHAVIOR OF ELECTROLYTIC SOLUTIONS AT ELEVATED TEMPERATURES AS DERIVED FROM CONDUCTANCE MEASUREMENTS. J. M. Wright, W. T. Lindsay, Jr., and T. R. Druga (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). June 1961. Contract AT-11-1-GEN-14. 36p.

Methods and techniques for measuring the conductances of reactor solutions at elevated temperatures and to interpret the results with electrolytic solution theories are discussed. Criteria applied to room-temperature conductances for determining complete ionization of 1–1 electrolytes were applied to the Noyes high-temperature conductance data obtained on NaCl, HCl, KCl, NaOH, $AgNO_3$, and H_3PO_4 solutions. It was found that the first four electrolytes behave as strong electrolytes up through temperatures of 218, 218, 281, and 156°C, respectively. Application of the Bjerrum theory showed that, somewhat above each of these temperatures, these electrolytes begin to associate by ion-pair formation. H_3PO_4 solutions associated at room temperature and above. $AgNO_3$ solutions appeared to associate at all temperatures. The equivalent conductances and infinite dilution and the dissociation constants for each of the electrolytes were calculated. An apparatus was constructed and measurements were made on the conductances of LiOH and NH_4OH solutions over the temperature range of 100 to 520°F. Equivalent conductances at infinite dilution were calculated. The pH of reactor coolants using LiOH or NH_4OH was calculated from the dissociation constants for water, LiOH, and NH_4OH at elevated temperatures. (auth)

24785 (AEC-tr-4057) JOURNAL OF INORGANIC CHEMISTRY. Translation of Zhurnal Neorganicheskoi Khimii, Volume II, No. 7, 1957. 434p. (PST-Cat.-84)

A total of 47 papers are included which treat various topics in inorganic chemistry. Separate abstracts have been prepared for five of the papers; of the remaining 42 papers, three were previously abstracted in NSA. (D.L.C.)

24786 (AEC-tr-4057(p.47-51)) ON THE EQUILIBRIUM $UI_4 \rightleftharpoons UI_3 + I$. M. M. Popov and M. D. Senin. Translated from Zhur. Neorg. Khim., 2: 1479-81(1957).

French translation available as CEA-tr-R-597.

UI_3 was obtained from dissociation of UI_4 at 700 to 750°C and found to have a density $d_4^{25} = 6.38$ g/cm^3 and a melting point of 766.6 ± 1°C. The equilibrium constant of the reaction UI_4 (gas) $\rightleftharpoons UI_3$ (liquid) + I(gas) was determined to be 4.57×10^{-2} at 1097°K and 5.37×10^{-2} at 1176°K, and the heat of formation of UI_4 (gas) was determined to be Q = 5.2 ± 0.7 kcal/mole. The maximum work of formation of UI_4 (gas) is 6.73 ± 0.05 and 6.83 ± 0.01 kcal/mole at 1097 and 1176°K, respectively. (D.L.C.)

24787 (AEC-tr-4057(p.350-8)) STUDY OF THE COPRECIPITATION OF OXALATES OF CERIUM AND LEAD. A. N. Kirgintsev. Translated from Zhur. Neorg. Khim., 2: 1672-6(1957).

Cerium was found to form anomalous mixed crystals with lead oxalate, and there is no lower limit of the miscibility. Bivalent lead ions were observed to prevent precipitation of cerium oxalate from supersaturated solutions. (D.L.C.)

24788 (AEC-tr-4057(p.385-90)) PREPARATION OF MOLYBDENUM DISILICIDE BY THE CARBON REDUCTION OF OXIDES. L. Ya. Markovskii and N. V. Vekshina. Translated from Zhur. Neorg. Khim., 2: 1693-6(1957).

Reduction of a stoichiometric mixture of $MoO_3 + 2\ SiO_2$ by C was found to result in a mixture of $MoO_5Si_3 + SiC + C$. However, pure $MoSi_2$ may be obtained if the reaction is forced at 1900°C with excess SiO_2. Some of the properties of prepared $MoSi_2$ samples are tabulated. (D.L.C.)

24789 (NP-tr-708) ON THE STABILITY OF SYMMETRICAL BIATOMIC MOLECULES OF THE TRANSITION ELEMENTS. (De La Stabilite Des Molecules Biatomiques Symetriques Des Elements Transitoires). G. Verhaegen (Brussels. Université). Translated for Wright Air Development Center. 9p.

The conditions required for observing the symmetrical biatomic molecules of the transition elements are investigated. Approximate dissociation energies are derived for Cr_2 and Pd_2, and correlations are developed for the quanti-

tative theoretical treatment of the chemical bond in the gas and condensed phases. (D.L.C.)

24790 (NP-tr-704) METALLOCHEMICAL PROPERTIES OF NIOBIUM. I. I. Kornilov. Translated from Doklady Akad. Nauk S.S.S.R., 135: 1399-1401(1960). 6p.

The metallic properties of niobium are discussed. As the basic characteristics of the metallochemical properties, the electron structure of the atom, the atomic radii, the electronegativity, the types of crystalline structure, and fusion temperature were determined. On the basis of a generalization of the published material on the chemical reactions of niobium with the elements of the periodic system, it was possible to make a classification of those elements from the point of view of their interaction with niobium. (M.C.G.)

24791 (UCRL-Trans-680) THE KINETICS OF THE SAPONIFICATION OF DIALKYLPHOSPHITES. II. GENERAL ACID- AND BASE-CATALYSIS AT THE HYDROLYSIS OF DIETHYLPHOSPHITE. Paul Nylen. Translated from Svensk Kem. Tidskr., 49: 79-96(1937). 43p. (Includes original, 20p.).

The hydrolysis of the dialkylphosphite is influenced catalytically not only by the hydrogen and hydroxyl ions but also by acids and bases in general. This acid and base catalysis was investigated in detail on the diethyl esters. The catalysis coefficients of some acid-base systems as well as their strength constants are given in tabular form. The connection between catalysis constants and strength constants given by the theory of Brönsted was confirmed for basic catalysis. For acid catalysis there was a pronounced difference between the carboxylic acids and other acids. The fact that the base catalysis in the reaction of the diethylphosphite with iodine did not coincide with the base catalysis in saponification, but was more than a thousand times greater, is discussed. (auth)

24792 THE STRUCTURE OF URANATES. E. A. Ippolitova and L. M. Kovba (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 138: 377-80(May 11, 1961). (In Russian)

A critical examination is made of the evidence for the structure of uranates. It is concluded that the uranates are not hydroxy-aquo complexes, since uranium forms discrete complexes such as $(UO_2F_4)^{2-}$, and the corresponding complex containing only water and hydroxyl groups is unknown. There is a structural similarity in aqueous and anhydrous uranates with the frequent occurrence of the repeating uranyl-oxygen group $(UO_2)O_2$ in the structure. A defect structure typical of $CaUO_4$ with hexagonal layers having a composition of $(UO_2)O_{1.5}$ is characteristic of the alkali diuranates. The polyuranates of a number of divalent metals such as ZnU_3O_{10} and MgU_3O_{10} belong to the double oxides which are structurally similar to α-UO_3 and the hexagonal modification of U_3O_8. Others such as CdO 3 to 5 UO_3, SrO 1.5 to 1.75 UO_3, and the $BaO-UO_3$ system are solid replacement solutions and have a structure close to that of UO_2. The structure of aqueous uranates, uranyl hydroxide, and uranyl basic nitrates is characterized by the presence of hexagonal or pseudo-hexagonal, uranyl-oxygen layers in which oxygen can be replaced by a hydroxyl group or by water. The solid uranates can be divided into two groups: 1) the true uranates with a structural unit whose composition depends on the composition of the uranate ($Me_3^{2+}UO_6$, $Me^{2+}(UO_2)O_2$, $Me_2^{+}(UO_2)O_2$, $Me^{+}(UO_2)O_{1.5}$, $Me_x^{+}UO_2(O,OH)_2$ etc.), and 2) the anhydrous polyuranates of divalent elements which are looked upon as double oxides or solid solutions. (TTT)

24793 MONOCITRATE COMPLEXES OF THE RARE EARTHS. D. I. Ryabchikov and E. K. Korchemnaya (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 397-8(May 11, 1961). (In Russian)

It has been shown previously by means of the series of precipitants $PO_4^{3-} > F^- > C_2O_4^{2-} > OH^- > [Fe(CN)_6]^{4-}$ that the rare earth complexes increase in strength with decreasing ionic radius from lanthanum to lutetium. Further investigation showed that the rare earths formed a 1:1 citrate complex which dissolves in NaOH. The composition of the lanthanum complex was found to be $LaC_6H_5O_7 \cdot 3H_2O$ by chemical analysis. This compound can be considered as a non-electrolyte in which the six coordination sites of La are occupied by a citrate radical and three molecules of water. Tracer experiments with $Eu^{152,154}$ showed that the rare earth forms an anion and is carried to the anode during electrolysis. A compound, isolated from an alkali solution by adding alcohol, gave a formula close to that of $Na[LaC_6H_5O_7 \cdot 2H_2O \cdot OH]$. It is assumed that one molecule of water dissociates to give the sodium salt. (TTT)

24794 THE BOLTZMANN EQUATION FOR FLOWS WITH CHEMICAL REACTIONS. J. M. Burgers (Univ. of Maryland, College Park). Planetary and Space Sci., 3: 4-11(1961).

An extended form is presented of the Boltzmann equation for the effect of collisions upon the distribution function, in which account is taken of chemical reactions that may result from collisions and of spontaneous processes (spontaneous change of quantum state with emission of radiation). In order to prevent the scheme from becoming too complicated, a number of assumptions had to be introduced. A discussion is given of the various terms which must be written on the right hand side of the Boltzmann equation. The extended form of the Boltzmann equation obtained in this way can be used for the deduction of continuity, momentum and energy equations, in which the production and the disappearance of molecular species finds a place along with diffusion. (auth)

24795 AN INVESTIGATION OF THE EFFECTS OF GASEOUS DIFFUSION ON THE RATE OF OXIDATION OF A METAL FORMING A VOLATILE OXIDE. D. R. Schryer and J. L. Modisette (NASA Langley Research Center, Langley Field, Va.). Planetary and Space Sci., 3: 31-7 (1961).

Data taken in flowing air and helium–oxygen mixtures have shown the oxidation rate of molybdenum to be dependent both on flow velocity and diffusivity in the temperature range 1945 to 2959°R. An extension of the Arrhenius equation to include flow and diffusion effects was found to correlate the data quite well for temperatures above 2400°R, at which the oxide formed was gaseous. The results obtained for molybdenum should be applicable to other metals forming volatile oxides in the appropriate temperature ranges. (auth)

24796 ENERGY TRANSPORT IN HIGH TEMPERATURE AND REACTING GASES. R. S. Brokaw (Lewis Research Center, NASA, Cleveland, Ohio). Planetary and Space Sci., 3: 238-52(1961).

Methods presently available for estimating convective and conductive heat transfer in high temperature gases are reviewed, emphasizing the role of viscosity and thermal conductivity. Examination of engineering heat transfer correlations shows that large errors in thermal conductivity and viscosity lead to considerably smaller errors in heat transfer coefficient provided transport properties are ob-

tained by techniques derived from rigorous kinetic theory. Because uncertanties in high temperature transport properties arise largely as a result of uncertainties in collision cross-sections, methods of estimating these cross-sections are considered; estimates show encouraging agreement with experiment for both stable and unstable species. Approximate formulas for viscosity and conductivity of mixtures are compared with rigorous formulas and with experiment. Heat conduction in reacting gases is then considered; in such mixtures the diffusional transport of chemical enthalpy may lead to thermal conductivities an order of magnitude greater than in similar, but nonreacting gases. Theoretical predictions of the equilibrium conductivity compare favorably with experimental data for the nitrogen tetroxide and hydrogen fluoride systems. When chemical reaction rates are not high enough to maintain chemical equilibrium locally in a temperature gradient, theory shows that the effective thermal conductivity is related to the ratio of a diffusion time to the chemical relaxation time; low pressure data for the nitrogen tetroxide system are in accord with this analysis. Finally it is shown that experimental convective heat transfer in practical systems can be treated by these methods. It is concluded that methods for calculating high-temperature heat transfer are in many respects well developed, so that rigorous calculations of the transport properties are often justified. (auth)

24797 MOLECULAR INTERACTIONS AT HIGH TEMPERATURES. C. E. Treanor and G. T. Skinner (Cornell Aeronautical Lab., Buffalo, N. Y.). Planetary and Space Sci., 3: 253-6(1961).

An experimental and theoretical program concerning the interactions between gas particles having energies in the 1 to 10 ev range is discussed. A molecular beam is constructed using a shock tube as the source of high-energy atoms and molecules. The interest centers around those interactions characteristic of high-temperature air where considerable dissociation has occurred. The atom-molecule interactions are given first consideration because of their importance in estimating transport properties. A two-center potential is used for preliminary investigation of the diatomic molecule as seen by an approaching atom. (auth)

24798 DROP DOSATOR FOR THE SYNTHESIS OF NUCLEAR EMULSION. O. P. Grigor'ev and L. I. Shur (Khlopin Radium Inst., Academy of Sciences, USSR). Zhur. Nauch. i. Priklad. Fot. i Kinematografii, 5: 223-4(1960).

An instrument is described which is very useful for manufacturing experimental nuclear emulsions. The basic part of the instrument is a working table on a mobile bracket. Glass dosing devices for the solutions of $AgNO_3$ and KBr are fixed, by means of clamps, to the table. The capilaries of the dosators are connected to specially designed jets by means of rubber hoses. The frequency of the droplets is controlled by changing the pressure exerted on the rubber hose by a strip which is loaded with adjustable weights. On the same table the motor of the blade mixer is fixed. The solution flows from the dosators through the perspex jet end-pieces, the shape of which is such as to ensure easier tearing away of the drop from the surface as a result of the pressure of the liquid column. By appropriate choice of the diameter of the jets it is possible to obtain any weight ratio of the salt solutions which determine the conditions of producing the emulsion. The operation is as follows: with the cocks closed and pressed down strips the glass dosators fill with solution. Then, the mobile table is placed above the vessel which is located in the thermostat in such a way that the mixer is covered with molten gelatin. After starting the mixer, the cocks of the dosator are opened and the strips are slightly relieved from pressure so that a drop of the solution is suspended on the jet. Then, by relieving the load, the solutions begin to flow, simultaneously regulating the frequency of the drops. (OTS)

24799 METHOD FOR PRODUCING DIBORON TETRACHLORIDE. Jack W. Frazer and R. T. Holzmann (to U. S. Atomic Energy Commission). U. S. Patent 2,994,652. Aug. 1, 1961.

A method of producing diboron tetrachloride from boron trichloride is described. Gaseous boron trichloride is passed through a cavity resonating at a microwave frequency whereby a portion of the boron trichloride is converted into diboron tetrachloride. The diboron tetrachloride may then be separated from the boron trichloride by conventional means. (AEC)

24800 PRECIPITATION OF PLUTONOUS PEROXIDE. J. G. Barrick and J. P. Manion (to U. S. Atomic Energy Commission). U. S. Patent 2,996,352. Aug. 15, 1961.

A precipitation process for recovering plutonium values contained in an aqueous solution is described. In the process for precipitating plutonium as plutonous peroxide, hydroxylamine or hydrazine is added to the plutonium-containing solution prior to the addition of peroxide to precipitate plutonium. The addition of hydroxylamine or hydrazine increases the amount of plutonium precipitated as plutonous peroxide. (AEC)

24801 PROCESS OF RECOVERING ALKALI METALS. Jasper Wolkoff (to U. S. Atomic Energy Commission). U. S. Patent 2,996,375. Aug. 15, 1961.

A process is described of recovering alkali metal vapor by sorption on activated alumina, activated carbon, dehydrated zeolite, activated magnesia, or Fuller's earth preheated above the vaporization temperature of the alkali metal and subsequent desorption by heating the solvent under vacuum. (AEC)

Analytical Procedures

24802 (AD-254125) DESENSITIZATION OF ZIRCONIUM POWDER USED IN PRIMERS (PHASE II). Development of Methods for the Determination of Hydrogen, Carbon, and Oxygen in Zirconium Powder). George Norwitz, John J. Jackiewicz, and Joseph Cohen (Frankford Arsenal, Philadelphia). Mar. 1961. 31p.

A sampling procedure was developed for Zr powder stored under water, and methods are presented for determination of H, C, and O in Zr powders. H and C are determined as H_2O and CO_2 by combustion of a single sample in the presence of Pb as a flux, while O is determined as ZrO_2 after the free Zr has been volatilized as $ZrBr_4$ by heating in Br_2 at ~825°C. Analytic results are presented for nondesensitized and desensitized Zr powders. It is concluded that the C and O content is not changed by the desensitization treatment, but that the H content increases by 0.03 to 0.04%. (D.L.C.)

24803 (AERE-AM-83) THE DETERMINATION OF SILICON IN ZIRCONIUM AND ZIRCALOY II. E. Bowell and P. T. S. Sandon (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Chatham Outstation, Kent, England). June 1961. 5p.

The sample is dissolved in hydrofluoric acid and the fluoride ion is complexed with boric acid. The silicon is then determined absorptiometrically as the reduced silicomolybdic acid complex. (auth)

24804 (AERE-AM-84) THE DETERMINATION OF RADIOACTIVITY DUE TO CAESIUM, STRONTIUM, BARIUM AND CERIUM IN WATERS. R. G. D. Osmond, T. W. Evett, J. W. Arden, M. B. Lovett, and B. Sweeney (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). May 1961. 46p.

Methods are described for the determination of Sr^{89}, Sr^{90}, Cs^{137}, Ba^{140}, Ce^{141}, and Ce^{144} in rain and tapwaters. Low background counting equipment is used in this work, and the lower limit of detection of any of the radionuclides is about 1 $\mu\mu$c. (auth)

24805 (CEA-1901) DOSAGE DES VAPEURS DE MERCURE DANS L'AIR. APPLICATION A UNE SURVEILLANCE D'AMBIANCE. (The Dosage of Mercury Vapours in Air. Application to an Atmospheric Control). H. Francois, M. C. Vettier, and Y. Moser (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 20p.

A technique was developed for trapping completely the Hg vapors in the atmosphere and analyzing them with precision. The analytical method used is particularly sensitive and makes possible the determination of 1 microgram of Hg in a 1000 liter sample of air with an accuracy of ±2%. The total time for the operation is about 2.5 hours, including the analysis. The operations are straightforward and can be carried out by specialized personnel after a short training period. (auth)

24806 (HW-SA-2195) THE FLAME PHOTOMETRIC AND EMISSION SPECTROGRAPHIC DETERMINATION OF CERIUM, NEODYMIUM AND THE ALKALINE EARTHS. R. Ko, A. C. Leaf, W. Y. Matsumoto, and M. R. Weiler (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [nd]. 7p.

A discussion is given of analytical methods developed and adapted for the determination of: calcium, strontium, and barium in Purex chemicals; and calcium, cerium, strontium, barium, and neodymium in strontium-90 recovery process samples. The methods used include flame photometry and emission spectroscopy. (B.O.G.)

24807 (HW-SA-2205) THE SEQUENTIAL DETERMINATION OF LEAD, STRONTIUM, AND ZIRCONIUM BY X-RAY EMISSION SPECTROMETRY. H. A. Treibs (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [nd]. 7p.

A discussion is given of a method for the preparation and analysis by x-ray emission methods of process samples for lead, strontium, and zirconium. The method was found to be rapid, relatively free from interferences, and of sufficient accuracy for present needs. (B.O.G.)

24808 (NYO-9118) A FEASIBILITY STUDY FOR THE USE OF AN EXTENDED Pm^{147} SOURCE FOR ANALYTICAL FLUORESCENCE SPECTROSCOPY. Final Report. Frederick Brech (Jarrell-Ash Co., Newtonville, Mass.). Oct. 31, 1960. Contract AT(30-1)-2491. 27p.

It was established that a Pm^{147} bremsstrahlung source is inferior to an x ray tube for fluorescence spectroscopy, if resolution is achieved with conventional crystal spectrometers. If for reasons of the price per curie and of the tolerable area of the sample to be radiated (20 cm^2) the upper limit of activity be set at 1000 curies, then the photon gathering power of the spectrometer geometry requires a 100-fold increase over that of the GE XRD-5 instrument. That instrument utilizes plane crystal geometry requiring the use of collimated radiation thereby to exhibit a low efficiency of photon gathering power. The design of a spectrometer with the requisite improvement presents a substantial challenge, but it is one within the realms of possibility. Improvements to the specific activity for Pm^{147} and to the efficiency of the bremsstrahlung yield by the use of admixed targets could give an improvement factor of 2. This would reduce the required gain to a factor of 50, and this is considered to be a practicable possibility. The development of appropriate target-source mixtures would improve the fluorescent yield from elements in the periodic table between Ag (47) and V (23). A Pm^{147} source requires a thickness no greater than 0.02 cm and at this value a 1000 curie source with a specific activity of 400 curies/gm would have an area of 20 cm^2. This is a convenient one for the handling and preparation of samples. (auth)

24809 (PG-REPORT-209) ANALYTICAL METHOD FOR THE DETERMINATION OF THE TOTAL ALPHA-ACTIVITY OF THE FEED SOLUTION TO THE PRIMARY SEPARATION PLANT. (United Kingdom Atomic Energy Authority. Production Group. Windscale, Sellafield, England). 1961. 5p.

A portion of the diluted sample solution containing about 0.06 mg of uranium is evaporated on a stainless steel counting disc and the α activity determined using an α proportional counter. (auth)

24810 (PG-Report-224) ANALYTICAL METHOD FOR THE DETERMINATION OF PARTICULATE URANIUM ON ATMOSPHERIC DUST ADHESION PLATES (FLUORIMETRIC METHOD). (United Kingdom Atomic Energy Authority. Production Group, Capenhurst, Ches., England). 1961. 7p.

Particles of dust adhering to the plate are removed by washing with petroleum ether. The residue after evaporation of the petroleum ether is wet oxidized and finally dissolved in dilute nitric acid. An aliquot of the solution is evaporated to dryness, the residue fused with sodium fluoride–sodium bicarbonate fusion mixture, and the uranium determined by measuring the fluorescence of the melt. (auth)

24811 (PG-Report-230) ANALYTICAL METHOD FOR THE DETERMINATION OF SULPHATE IN FERROUS SULPHAMATE FEED SOLUTIONS (E.D.T.A. TITRATION METHOD). (United Kingdom Atomic Energy Authority. Industrial Group. Windscale Works, Sellafield, Cumb., England). 1961. 4p.

The sample is passed down a cation exchange column and the eluate treated with standard barium chloride solution. After standing, the excess barium chloride is determined by titration with EDTA to Solochrome Black Indicator. (auth)

24812 (WADD-TR-60-482) ANALYSIS OF GASES IN METALS. Josef J. Schmidt-Collerus and Andrew J. Frank (Denver. Univ. Denver Research Inst.). Aug. 1, 1960. Contract AF33(616)-6381. 43p.

An investigation was undertaken to determine the feasibility of using gas chromatographic techniques in the determination of nitrogen in metals. The resolution of extracted nitrogen, hydrogen, oxygen, and carbon monoxide by a molecular sieve 5A chromatographic column is demonstrated. The chromatographic sensitivity is shown to be adequate for ppm determinations. An apparatus which combines gas extraction from metallic samples, gas transfer, and chromatographic analysis is described and recommendations presented for further improvement in system operation. The application of the basic principle for the determination of nitrogen in magnesium and ingot iron with the developed apparatus was also investigated. To date these determinations gave largely negative results; reasons for the failures are attributed to apparatus shortcomings and corrective measures are proposed. Extension of the ana-

lytical method to inert-gas fusion extraction is discussed. (auth)

24813 (WAPD-DLE-341) THE PRESENT STATE OF DEVELOPMENT OF ANALYTICAL METHODS FOR DETERMINING LOW CONCENTRATIONS OF CHLORIDE ION IN REACTOR WATERS. J. H. Lady and K. B. Adams (Westinghouse Electric Corp. Research Labs., Pittsburgh). July 1, 1958. For Bettis Atomic Power Lab. Contract NObs-67500. 11p.

A summary of the present state of development is given and proposed areas of investigation including analyses based on emission spectroscopy, coulometry, calorimetry, radioactive exchange, potentiometry, and catalysis are discussed. It is noted that theoretical limitations should be examined in each case to assess the potential of the various methods. A development program should then be followed to reduce the most feasible approach to the desired low concentration limits. (J.R.D.)

24814 (AEC-tr-4057(p.376-84)) DETERMINATION OF GOLD AND PLATINUM METALS IN REFINED SILVER AND CATHODE NICKEL BY MEANS OF THE RADIOACTIVE METHOD. O. E. Zvyagintsev and A. I. Kulak. Translated from Zhur. Neorg. Khim., 2: 1687-92(1957).

Activation techniques are given for the determination of gold, platinum, palladium, and iridium in refined silver and cathode nickel. (D.L.C.)

24815 CATHODIC ACTION OF THE URANYL-EDTA COMPLEX AT THE DROPPING MERCURY ELECTRODE. Tsai-Teh Lai and Teh-Liang Chang (Cheng Kung Univ., Tainan, Taiwan). Anal. Chem., 33: 1193-6(Aug. 1961).

The polarographic behavior of the uranyl–(ethylenedinitrilo)tetraacetate complex was studied over the pH range 3.3 to 9.3. A reversible wave corresponding to the reduction of the uranyl complex to the U(V) state was obtained in the range. The half-wave potential was found to be independent of pH from 5.7 to 6.8 and equal to –0.37 volt vs SCE; outside the range the half-wave potential is pH-dependent, and it is shown that one hydrogen or hydroxyl ion is involved in the reduction. It was proved that U(VI) has one more ligand attached than U(V) in the pH range from 3.3 to 6.8, but has the same number of ligands between 6.8 and 9.3. The diffusion current is proportional to concentration of uranyl ion from 2.20×10^{-4} M to 2.4×10^{-3} M. The diffusion current constant is 2.18 for 7.13×10^{-2} M Versene at pH 5.50 and the diffusion coefficient is 1.30×10^{-5} cm^2 per second. (auth)

24816 CAPILLARY BEHAVIOR IN HIGH SENSITIVITY POLAROGRAPHY. W. D. Cooke (Cornell Univ., Ithaca, N. Y.), M. T. Kelley, and D. J. Fisher. Anal. Chem., 33: 1209-15(Aug. 1961).

A study was undertaken to ascertain the factors that limit the sensitivity of polarography with the dropping mercury electrode. Some sources of the capillary noise were discovered and a capillary was designed which greatly reduces the erratic nature of polarographic backgrounds at high sensitivity and extends the scope of polarographic methods to more dilute solutions. By using an ORNL Model Q-1988-ES controlled-potential and derivative polarograph with modified capillaries, it is possible to detect reducible species which would give diffusion currents as small as 0.0002 μa by conventional methods. In the case of zinc, this corresponds to a concentration of 0.006 μg per ml. The results of the investigation emphasize that the mechanical design of the dropping mercury capillary is an important polarographic parameter. (auth)

24817 DETERMINATION OF CARBON-14 IN AQUEOUS BICARBONATE SOLUTIONS BY LIQUID SCINTILLATION COUNTING TECHNIQUES. APPLICATION TO BIOLOGICAL FLUIDS. Gerald A. Bruno and John E. Christian (Purdue Univ., Lafayette, Ind.). Anal. Chem., 33: 1216-18(Aug. 1961).

Using Cellosolve as a solubilizing additive, up to 5.84 ml of aqueous bicarbonate solutions and essentially equivalent amounts of urine and plasma containing carbon-14–sodium carbonate can be assayed by liquid scintillation counting techniques. Of particular significance is the realization of determining carbon-14 activity with relatively high efficiency in the important biological fluids. (auth)

24818 LIQUID SCINTILLATION TECHNIQUES APPLIED TO COUNTING PHOSPHORESCENCE EMISSION. MEASUREMENT OF TRACE QUANTITIES OF ZINC SULFIDE. J. D. Ludwick and R. W. Perkins (General Electric Co., Richland, Wash.). Anal. Chem., 33: 1230-5(Aug. 1961). (HW-SA-2063)

The analytical procedure is based on electronically counting the individual phosphorescence photons following light-excitation for the measurement of scintillation grade zinc sulfide particles on molecular air filters. The zinc sulfide was collected on these filters during meteorological studies of particle dispersion. The analytical procedure involves dissolving a zinc sulfide laden filter in an ethyl alcohol–ethyl acetate solvent, exposing the sample to a fluorescent lamp, allowing the sample to decay (in the dark) for a predetermined time, then counting the phosphorescence photon emission. The counting equipment requirements are similar to those commonly used for counting tritium. The conditions of excitation and measurement yielded a sensitivity of about 10^{-8} gram. A sensitivity improvement of one to two orders of magnitude could probably be obtained by minor precedural changes. The precision of the zinc sulfide measurements on clean and dirty filters is about ±3% and ±6% standard deviation. Corrections for loss in counting efficiency on dirty filters are made from absorbance measurements with a colorimeter. (auth)

24819 ABSORPTION SPECTRA OF THE LANTHANIDES IN FUSED LITHIUM CHLORIDE–POTASSIUM CHLORIDE EUTECTIC. Charles V. Banks, Merlyn R. Heusinkveld, and Jerome W. O'Laughlin (Ames Lab., Ames, Iowa). Anal. Chem., 33: 1235-40(Aug. 1961).

Spectra are presented for solutions of Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, and Yb fluorides in fused LiCl–KCl eutectic at 400°C. The spectra are discussed and compared with similar results which were obtained in the same and other fused salt media and in aqueous solutions. Molar absorptivities for selected absorption bands of the rare earth spectra which might be useful in quantitative analytical determinations are also given. (auth)

24820 DETERMINATION OF MICRO RHODIUM FILM THICKNESS AND OF GOLD PLATING THICKNESS ON PRINTED CIRCUITS BY BETA RADIATION BACKSCATTER MEASUREMENTS. V. L. Eggebraaten, L. J. Walker, and E. W. Strobelt (Boeing Airplane Co., Seattle). Anal. Chem., 33: 1245-7(Aug. 1961).

Beta radiation backscatter techniques were applied to thickness measurements of gold plating on printed circuit cards and of very thin rhodium films vaporized on a sapphire crystalline base. Gold thicknesses between 100 to 500 μcm were determined with an accuracy of 18 μcm. Rhodium film thickness was measured from 0.5 to 5 μcm with an accuracy of 0.5 μcm. The method of analysis described is nondestructive and is designed to give sensitive and reliable results. (auth)

24821 DETERMINATION OF BERYLLIUM IN ORES AND ROCKS BY A DILUTION-FLUOROMETRIC METHOD WITH MORIN. Rving May and F. S. Grimaldi (Geological Survey, Washington, D. C.). Anal. Chem., 33: 1241-3(Aug. 1961).

Beryllium in concentrations as little as a few parts per million is determined fluorometrically with morin in low grade ores by a dilution method without separations. A high sensitivity is obtained by the adoption of instrumental and reaction conditions that give a satisfactory ratio of beryllium to blank fluorescence and at the same time minimize iron interference. Data on the behavior of 47 ions are given. The method is applied to ores containing bertrandite and beryl as the beryllium minerals. (auth)

24822 DETERMINATION OF TUNGSTEN IN TUNGSTEN METAL AND THORIATED TUNGSTEN BY A COMBINATION OF GRAVIMETRIC AND SPECTROPHOTOMETRIC TECHNIQUES. George Norwitz (Frankford Arsenal, Philadelphia). Anal. Chem., 33: 1253-7(Aug. 1961).

Most of the tungsten is precipitated free from contaminants and the residual tungsten is determined colorimetrically by an improved thiocyanate procedure. The amount of cinchonine used does not interfere with the thiocyanate color. Molybdenum does not interfere. Good precision was obtained and the results compare favorably with the nominal tungsten content as determined by difference. The method is recommended for the determination of tungsten in fabricated tungsten metal, high or moderate purity tungsten powders, and thoriated tungsten. (auth)

24823 PYROLYTIC SEPARATION AND DETERMINATION OF FLUORIDE IN RAW MATERIALS. M. J. Nardozzi and L. L. Lewis (United States Steel Corp., Monroeville, Penna.). Anal. Chem., 33: 1261-4(Aug. 1961).

Pyrolytic separation was applied to the problem of determining the fluoride content of diverse inorganic mixtures. In the technique a sample is mixed with tungstic oxide as a reaction accelerator and placed in a quartz tube heated to 1000°C. Moist oxygen is passed over the mixture, and the fluoride, which is liberated quantitatively, is swept through the tube and collected for the determination. Separation time was reduced to 15 minutes for samples of iron ore, slag, glass, and certain minerals. The separated fluoride is determined titrimetrically or spectrophotometrically. (auth)

24824 SEPARATION OF THORIUM BY ANION EXCHANGE. Johann Korkisch and Fouad Tera (Universität, Vienna). Anal. Chem., 33: 1264-6(Aug. 1961).

Two methods are described for the separation of thorium from a number of elements by a two-cycle anion exchange. The first method utilizes the adsorption of the negatively charged nitrate complex of thorium on the strongly basic anion exchanger Dowex 1-X8 (nitrate form) from a solution consisting of 90% methanol and 10% 5N nitric acid. All elements except barium, lead, bismuth, lanthanum, and rare earth elements, which are also adsorbed, can be separated from thorium quantitatively. To separate thorium from these elements (except bismuth) a second ion exchange method was employed, based on the fact that thorium at pH 4 forms a negatively charged ascorbinate complex which is strongly adsorbed on Dowex resin 1-X 8 (ascorbinate form), whereas the accompanying elements pass into the effluent unadsorbed. Thoronol was used as a colorimetric reagent for the spectrophotometric determination of thorium. (auth)

24825 ANION EXCHANGE SEPARATION OF ZIRCONIUM, TITANIUM, NIOBIUM, TANTALUM, TUNGSTEN, AND MOLYBDENUM. W. R. Bandi, E. G. Buyok, L. L. Lewis, and L. M. Melnick (United States Steel Corp., Monroeville, Penna.). Anal. Chem., 33: 1275-8(Aug. 1961).

The anion exchange behavior of these six metals in solutions that contained two or more of the reagents hydrochloric acid, oxalic acid, citric acid, ammonium chloride, ammonium citrate, and hydrogen peroxide was studied, and separation conditions were established. Information on column size and volumes required for the selective elutions as well as analytical results on synthetic and standard samples, is presented. (auth)

24826 ABSORPTIOMETRIC METHODS FOR THE DETERMINATION OF BORON. J. Borrowdale, R. H. Jenkins, and C. E. A. Shanahan (Richard Thomas and Baldwins Ltd., Whitchurch, Aylesbury, Bucks, Eng.). Analyst, 86: 489(July 1961).

Results showing the influence of drying temperature on optical-density readings are given. The method used to obtain the results is also described. (P.C.H.)

24827 POSSIBILITY OF SUBSTANTIAL INTENSIFICATION OF THE SPECTRA OF IMPURITIES PRESENT IN URANIUM AND THE APPLICATION IN A DIRECT SPECTROCHEMICAL ANALYSIS OF URANIUM OXIDES. Slobodan N. Marinković. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 163-72(Mar. 1961). (In English)

The fact previously established that the matrix can affect substantially the behavior of impurities in the spectrochemical analysis of uranium by the Scribner-Mullin method, has been used to enhance the line intensities and improve detection limits of impurities. Relatively simple procedure of hydrogen reduction of U_3O_8 to UO_2 prior to arcing, enhances line intensities of a number of impurities to such an extent as to correspond to an increase of concentration by a factor of 2.5 to 8 (depending on the element). By means of the developed quantitative method which applies this effect, it is possible to determine 19 elements with a precision of 10 to 15%, and with high detection limits. The fact that the arcing of UO_2, prepared by hydrogen reduction of U_3O_8, leads to an intensification of the spectra of impurities, caused by an increase in their evaporation, could be explained by different interactions of the matrix with impurities in case of reduction during the arcing and reduction in hydrogen, respectively. The effect of the reducing action of hydrogen on impurity oxides is superimposed with this effect. (auth)

24828 SEPARATION AND DETERMINATION OF OXYPHOSPHORIC ACIDS BY PAPER CHROMATOGRAPHY. N. M. Cvjetićanin and I. D. Obernović. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 173-9(Mar. 1961). (In English)

A method has been developed for the separation and determination of small quantities of oxyphosphoric acids by paper chromatography. This method was worked out with the aim of examining the purity of the isotopes of phosphorus-32. A mixture of equal volumes of methanol, dioxane and ammonia was used as the solvent for separation. The spectrophotometric Lucena-Conde, Prat method suitable for small concentrations of phosphorus was used for the quantitative determination of phosphorus in various ionic forms. (auth)

24829 HIGH SENSITIVITY DETECTION OF NATURALLY OCCURRING RADIOCARBON. I. CHEMISTRY OF THE COUNTING SAMPLE. M. A. Tamers, J. J. Stipp, and J. Collier (Univ. of Texas, Austin). Geochim. et Cosmochim. Acta, 24: 266-76(July 1961). (In English)

The most promising method of increasing the sensitivity of radiocarbon dating is the use of radiation detection tech-

niques that are capable of counting large quantities of carbon. The liquid scintillation spectrometer is an instrument that is applied in several cases to increase the efficiency of C^{14} dating. A means is presented by which the entire counting solution (not including the small amounts of phosphors) can be synthesized from the sample to be dated. The solvent used is benzene, which is one of the most suitable materials for liquid scintillation counting since it contains 92% carbon and shows no scintillation quenching properties. The chemistry involved in the complete synthesis of benzene is described in detail. The sample to be dated is burned and carbon dioxide collected in ammonium hydroxide solution. Strontium carbonate is precipitated upon the addition of strontium chloride. The dried carbonate is mixed with magnesium powder and strontium carbide is produced by ignition of the mixture in an evacuated stainless steel tube. Reaction of the carbide with water generates acetylene which is led into a circuit containing dry ice-cooled traps and a pyrolysis tube at 600°C. The acetylene polymerizes to benzene. This is collected in the cooled traps and then purified by distillation. The over-all yield in the synthesis is 30%. The chemical steps involve no special equipment or training. A 20-ml sample can be produced by two man-days of work and the entire procedure completed in less than a week. (auth)

24830 A SHORT NOTE ON THE RELATIVE ABUNDANCE OF RUBIDIUM AND STRONTIUM IN VITRAIN ASHES FROM COALS IN NOVA SCOTIA. W. M. Tupper (Carleton Univ., Ottawa) and D. H. Loring. Geochim. et Cosmochim. Acta, 24: 314-15(July 1961). (In English)

The relative abundance of rubidium and strontium in vitrain ashes from coals in Nova Scotia is determined. Two vitrains are analyzed for Rb and Sr by isotope dilution. Six vitrains are analyzed for Rb by spectrochemical analysis. Of the two methods the isotope dilution method is the more reliable. (N.W.R.)

24831 USE OF PHOTOELECTRIC PHOTOMETRY FOR STUDYING THE LUMINESCENCE OF URANIUM-ACTIVATED SODIUM FLUORIDE. Z. M. Sverdlov (All-Union Geological Scientific Research Inst., USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 510-12(Apr. 1961). (In Russian)

Visual photometry is widely used for determining the U content of molten NaF; the sensitivity and the precision of the method were greatly improved by the use of a photoelectric photometer. The experimental arrangement included a light source, a photomultiplier, a d-c amplifier and a supply system consisting of a ferroresonance voltage stabilizer. Amounts of 10^{-10} g of U could be determined with the apparatus in about 4 mg of NaF with a reproducibility of results within 2%. The determination may also be carried out by measuring the intensity of the luminescence excited by the ultraviolet radiation of $\lambda = 366$ mμ and of the visible radiation of $\lambda = 405$ and 436 mμ and by determining the absorption of the 253.7, 313, 366, 405, 436, and 579 mμ lines of the Hg spectrum. (TTT)

24832 DETERMINATION BY ALPHA SPECTROMETER OF Pu^{239} IN A SPECIMEN OF IRRADIATED NATURAL URANIUM. R. Bertrand (Centre d'Etudes Nucléaires, Mol, Belg.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 14: 49-50(Apr. 1961). (In French)

A method is described for measuring the amount of Pu^{239} formed in neutron-irradiated natural U. The sample, after exposure to an integral flux of about 10^{18} nvt, is dissolved in acid and deposited in a thin film on stainless steel plaques. The amount of Pu^{239} formed is found from the α spectra of the sample, with the U^{234} and U^{238} peaks used as internal standards. This method is quite efficient in the range of Pu^{239}/U^{234} intensity ratios from 0.1 to 1.0; other methods are described for higher ratios. The method may be used to find the depth dependence of Pu^{239} formation in cylindrical bars. (T.F.H.)

24833 IMPROVED FLUORIMETER FOR URANIUM ANALYSIS. E. N. Haran (Ministry of Defence, Tel-Aviv, Israel). J. Sci. Instr., 38: 273-7(July 1961).

A stable fluorimeter, easily operated and serviced, has been developed. Drifts are reduced to a minimum by measuring only the alternating component of the fluorescent light. The exciting ultra-violet radiation is held at a constant level by a special light-stabilizing circuit. The radiation remains stable within ±1% for power line variations over the range of 200 to 250 v. The initial warm-up is less than 3 minutes compared with 10 to 15 minutes without the light-stabilizing circuit. The sensitivity of the instrument is to better than 10^{-9} gram uranium per fused pellet. (auth)

24834 LIQUID SCINTILLATION COUNTING OF TRITIUM IN URINE. J. A. B. Gibson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. in Med. Biol., 6: 55-64(July 1961).

An instrument is described using a single cooled photomultiplier for routine analysis of tritium in urine. The quenching effects and luminescence of urine treated by various methods are determined. For urine treated with activated charcoal the average activity required to double the background counting rate is 2 nanocuries per ml with an efficiency of 5%. The effects of temperature on the background count rate and the counting efficiency are determined. The complications introduced by C^{14} activity in the urine are considered. (auth)

24835 FLUOROMETRIC DETERMINATION OF ZIRCONIUM WITH QUERCETIN. SEPARATION OF INTERFERENCES BY EXTRACTION WITH TTA. David M. Hercules (Juniata Coll., Huntingdon, Penna.). Talanta, 8: 485-91(July 1961). (In English)

The fluorometric determination of microgram quantities of zirconium in the presence of milligram quantities of interfering elements (particularly iron, vanadium and titanium) is described. The method involves extraction of zirconium with 2-thenoyltrifluoroacetone and development of fluorescence with quercetin. A study of experimental variables is included. The precision of the method is ±4%. (auth)

24836 THE CONSECUTIVE RADIOMETRIC TITRATION OF SEVERAL ELEMENTS WITH THE SODIUM SALT OF 1-DITHIOCARBOXY-3-METHYL-5-PHENYLPYRAZOLINE CONTAINING SULPHUR-35. A. I. Busev and V. M. Byr'ko (Moscow State Univ.). Talanta, 8: 492-6(July 1961). (In English)

The possibility is demonstrated of the consecutive radiometric titration of a number of combinations of elements, such as $Tl^{3+}-In^{3+}$, $Tl^{3+}-Zn^{2+}$, and $Cd^{2+}-Zn^{2+}$. New forms of radiometric titration curves are obtained. (auth)

24837 COLOUR REACTIONS OF SOME 1,4-DIHYDROXYANTHRAQUINONES WITH ALUMINIUM AND BERYLLIUM. E. Guy Owens, II and John H. Yoe (Univ. of Virginia, Charlottesville). Talanta, 8: 505-17(July 1961). (In English)

The color reactions of 2-quinizarinsulfonic acid (sodium salt) and 2-phenoxyquinizarin-3,4'-disulfonic acid (dipotassium salt) with aluminum or beryllium were studied and compared with the normal acid-base color changes.

pK values for these compounds were determined spectrophotometrically and compared with the ionization of 1,2-dihydroxyanthraquinone-3-sulfonic acid (sodium salt). The application of the color reactions of 2-phenoxyquinizarin-3,4'-disulfonic acid (dipotassium salt) with aluminum and beryllium to the spectrophotometric determination of both metallic ions is discussed. (auth)

24838 ISOTOPIC DILUTION ANALYSIS BY SOLVENT EXTRACTION. III. HIGHLY SELECTIVE DETERMINATION OF TRACE AMOUNTS OF MERCURY. Jaromír Růžička and Jiří Starý (Faculty of Technical and Nuclear Physics, Prague). Talanta, 8: 535-8(July 1961). (In English)

Mercury is determined by dithizone in amounts of 10^{-6} to 10^{-7} g/ml with an average precision of ±0.5% and in amounts of 10^{-8} to 10^{-9} g/ml with an average precision of ±2.5%. The determination of smaller amounts of mercury was subject to larger errors because of the lower specific activity of the radio-mercury employed. In the analysis even a significant excess of metals which also form extractable complexes with dithizone does not interfere. The method is very rapid and simple, because it consists of a single extraction of the analyzed solution, and measurement of the activity of the extract. The procedure which is worked out is far more precise and sensitive than the colorimetric determination of mercury by dithizone or other organic agents. (auth)

24839 SPECTROPHOTOMETRIC STUDY OF THE COMPLEX OF LANTHANUM AND ALIZARIN RED S. Toshi Kawashima (Electrical Communication Lab., Tokyo), Haruno Ogawa, and Hiroshi Hamaguchi. Talanta, 8: 552-6(July 1961). (In English)

The complex of lanthanum with alizarin Red S in acetate medium is studied spectrophotometrically since it appears to be promising for the determination of the chemical yield in radioactivation analysis of rare earth elements. At pH 4.6 (acetate buffer) the molecular ratio lanthanum: alizarin Red S is 1 : 2. (auth)

General Inorganic and Physical Chemistry

24840 (ANL-6364) PURIFICATION OF FLUORINE BY DISTILLATION. L. Stein, E. Rudzitis, and J. L. Settle (Argonne National Lab., Ill.). June 1961. Contract W-31-109-eng-38. 16p.

A vacuum-jacketed metal still for purifying half-pound quantities of commercial fluorine is described. Operating characteristics of a prototype still and of the present still are reported. The distillate is analyzed by an improved mercury-titration method, and a middle fraction of 99.9% or higher purity is collected. The impurities found in several cylinders of commercial fluorine by infrared and mass spectrographic analyses include N, O, CO_2, NF_3, HF, CF_4, C_2H_6, C_3H_8, OF_2, Ar. (auth)

24841 (GAMD-865) THE OPACITIES AND EQUATIONS OF STATE OF SOME MIXTURES OF LIGHT ELEMENTS. J. Bernstein (General Atomic Div., General Dynamics Corp., San Diego, Calif.). July 6, 1959. Project Orion. Contract AF18(600)-1812. 9p.

Calculations on HF, H_6BC, LiH, NH_3, H_2O, and CH_2 at 5–20 ev and H at 2.5–20 ev are given. (P.C.H.)

24842 (HMI-B16) TABELLEN FÜR DIE AUSWERTUNG VON MESSUNGEN DER DIFFUSION RADIOAKTIVER EDELGASE AUS FESTEN STOFFEN NACH BESTRAHLUNG (EDELGASDIFFUSION IN FESTKÖRPERN 5). (Tables for the Evaluation of Measurements of Radioactive Rare Gas Diffusion from Solid Material after Irradiation (Rare Gas Diffusion in Solid Bodies 5)). K. E. Zimen (Hahn-Meitner-Institut für Kernforschung, Berlin). May 1961. 38p.

For the evaluation of post-activation diffusion, the general equation for gas diffusion was numerically evaluated for specific model shapes. The results are tabulated and make possible a reading of the parameters for diffusion directly from a measured fraction of rare gas in the gas phase and in the solid body. (J.S.R.)

24843 (HW-SA-2204) THE EQUILIBRIUM CONTROLLED REDUCTION OF URANIUM CHLORIDE BY MOLTEN ALUMINUM IN A FUSED SALT SOLVENT. R. H. Moore (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 5, 1961. Contract AT(45-1)-1350. 8p.

A study was made of the effects of composition and temperature changes on the equilibrium distribution of uranium between the salt and metal phases, during the reduction of UCl_3 by aluminum in the presence of a flux of aluminum chloride-potassium chloride. Graphs are included showing the distribution of uranium at various flux ratios, and the variation in the concentration as a function of the mole flux ratio. (B.O.G.)

24844 (IDO-14546) STEAM STRIPPING TBP-AMSCO SOLUTIONS FROM NON-VOLATILE CONTAMINANTS. C. R. Ford and H. V. Chamberlain (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). May 12, 1961. Contract AT(10-1)-205. 17p.

The feasibility of continuous steam stripping of TBP–Amsco solutions from non-volatile contaminants in a packed column was studied using an uncontaminated solvent feed. Correlations of the experimental data show the effects of solvent feed rate, column temperature, packing height, and TBP concentration on the weight ratio of carrier steam-to-solvent feed required to produce a given column bottoms rate. Semi-continuous operation of a plant column is recommended in preference to continuous operation because of control problems inherent in the latter approach. (auth)

24845 (OOR-2069:4) A SPIN-FORBIDDEN TRANSITION OF NO OBSERVED IN SOLUTION SPECTRA. Technical Report No. 5 on Reactions of Nitrogen(II) Oxide. R. S. Drago and T. S. Piper (Illinois. Univ., Urbana. Noyes Lab. of Chemistry). [1961]. Contract DA-11-022-ORD-2772. 7p.

The transition $^4\pi \leftarrow X^2\pi$ occurs at 3.5 ev in the ultraviolet spectra of NO dissolved in organic solvents. The observed ω_e values range from 1100 cm^{-1} in CCl_4 to 1600 cm^{-1} in CH_3OH. These trends are correlated to the shift of electron density out of the π antibonding level upon formation of hydrogen bonds with the solvent. Investigations of the absorption spectrum of nitric oxide in polar solvents led to the discovery of a band with well resolved vibrational fine structure commencing at 3850A and extending to shorter wavelengths. This band is not observed in the gaseous spectra. The band was analyzed assuming that it is caused by a spin-forbidden transition to the state $^4\pi$ predicted by Mulliken at about 4.5 ev above the $^2\pi$ ground state. (auth)

24846 (TID-13073) NUCLEATION AND COPRECIPITATION FROM HOMOGENEOUS SOLUTION. Annual Progress Report. Louis Gordon, Kazuyoshi Takiyama, Jacob Block, Norton Haberman, Thomas H. Richert, and Eugene D. Salesin (Case Inst. of Tech., Cleveland). June 1, 1961. Contract AT(11-1)-582. 218p.

A discussion is given of researches conducted in the areas of nucleation, coprecipitation, development of reactions for precipitating metal chelates, and analytical methods. Separate abstracts were prepared for eight of the individual reports and reprints. (B.O.G.)

24847 (TID-13073(p.1-21)) NUCLEATION OF THORIUM 8-HYDROXYQUINOLATE FROM HOMOGENEOUS SOLUTION. Kazuyoshi Takiyama (Case Inst. of Tech., Cleveland).

The nucleation process was observed by light scattering and spectrophotometry. The number of particles formed in the mixture was determined by measuring the relative turbidity, degree of precipitation, dissymmetry, crystal growth rate, and size distribution. Solubility data are given for thorium 8-hydroxyquinolate in 8-hydroxyquinoline, acetone, and water at various acidities. Relations between absorbance, dissymmetry, turbidity, quantity of precipitate, and relative number of particles as a function of time are included in graphical form. (B.O.G.)

24848 (TID-13073(p.22-9)) NUCLEATION OF LEAD CHROMATE FROM HOMOGENEOUS SOLUTION. Norton Haberman (Case Inst. of Tech., Cleveland).

The experimental methods were refined to increase the validity of the results of the nucleation studies. Results of a typical run are shown graphically as chromate concentration and turbidity, concentration of lead precipitated, and ion product as functions of time. An analysis of the data showed that changes in the initial lead concentration and rate of chromate ion generation did not affect the critical supersaturation of the solution. (B.O.G.)

24849 (TID-13073(p.30-4)) PRECIPITATION OF TANTALUM AND NIOBIUM FROM HOMOGENEOUS SOLUTION. Thomas H. Richert (Case Inst. of Tech., Cleveland).

An outline is given of an experimental procedure for the precipitation of 5-mg amounts of tantalum from homogeneous solutions. A discussion is included of the derivation of the homogeneous distribution law and the Doerner-Hoskins law for describing coprecipitation. Distribution runs were made and the homogeneous and Doerner-Hoskins coefficients were calculated. The results show a distribution coefficient greater than one, thus indicating an enrichment system. (B.O.G.)

24850 (TID-13073(p.35-68)) PRECIPITATION OF NICKEL DIMETHYLGLYOXIMATE FROM HOMOGENEOUS SOLUTION. Eugene D. Salesin (Case Inst. of Tech., Cleveland).

The investigation of the reaction between biacetyl and hydroxylamine with ammoniacal nickel(II) solutions was conducted to study the nucleation phenomena associated with the precipitation of an insoluble metal chelate from an initially homogeneous solution, the kinetics of the reactions leading to the precipitation of the chelate, and to develop an improved gravimetric analysis method for the determination of the metallic ion. Spectrophotometric absorption maxima, molar extinction coefficients, and polarographic half-wave potentials are tabulated for the components of the reactions. Graphical representations are given of the results of the study. (B.O.G.)

24851 (TID-13073(p.72-165)) COPRECIPITATION WITH URANOUS OXALATE (thesis). Jacob Block (Case Inst. of Tech., Cleveland). 1961.

The technique of precipitation from homogeneous solution was used to study the coprecipitation of scandium(III) and cerium(III) individually with uranous oxalate hexahydrate. The systems followed the logarithmic distribution law more closely than the homogeneous distribution law. The coprecipitation of scandium(III) with uranous oxalate resulted in an apparent high degree of coprecipitation in the early stages, which could be significantly reduced by the prior addition of carrier crystals to the system. The cerium(III)-uranous oxalate system followed the logarithmic distribution law modified for ionic charge differences between carrier and tracer. The logarithmic distribution coefficient was found to be a ratio of the fractional rates of precipitation of tracer and carrier respectively; while the type of distribution expression followed is believed to be functionally related to the kinetics of the precipitation process. (auth)

24852 (TID-13073(p.166-74)) PRECIPITATION OF METAL 8-HYDROXYQUINOLATES FROM HOMOGENEOUS SOLUTION. III. ALUMINUM. David J. Marec, Eugene D. Salesin, and Louis Gordon (Case Inst. of Tech., Cleveland).

A study was made of the precipitation of aluminum from homogeneous solution with 8-acetoxyquinoline. The use of 8-acetoxyquinoline results in an aluminum precipitate with superior physical characteristics as compared to that produced in the conventional manner with 8-hydroxyquinoline. A separation of 25-mg quantities of aluminum from 300 mg of magnesium or 1000 mg of calcium can easily be made. (auth)

24853 (TID-13073(p.175-91)) GENERATION OF REAGENTS IN HOMOGENEOUS PHASE. Jacob Block, E. D. Salesin, and Louis Gordon (Case Inst. of Tech., Cleveland).

For Scott's "Standard Methods of Chemical Analysis," Van Nostrand.

An outline is presented of reactions used to precipitate elements from homogeneous solutions, elements precitated, diverse ions studied, and pertinent references to studies of the precipitation methods. (B.O.G.)

24854 (TID-13073(p.192-201)) PRECIPITATION OF METAL 8-HYDROXYQUINOLATES FROM HOMOGENEOUS SOLUTION. IV. URANIUM. Jon Bordner, E. D. Salesin, and Louis Gordon (Case Inst. of Tech., Cleveland).

Uranium(VI) 8-hydroxyquinolate can be precipitated from homogeneous solution with 8-hydroxyquinoline generated by the hydrolysis of 8-acetoxyquinoline. The composition of the uranium chelate formed is not the same for the two procedures described for the quantitative precipitation of the uranium. (auth)

24855 (TID-13337) [SPECTROPHOTOMETRIC INVESTIGATION OF THE RATIO OF TWO WEAK ACID DISSOCIATION CONSTANTS]. Technical Progress Report, 1960–1961. James Y. Tong (Ohio Univ., Athens). Contract AT(11-1)-678. 47p.

The ratio of the concentration equilibrium constants of the second dissociation of chromic acid and phosphoric acid, Q_{12}/Q_2, was determined in 1 M sodium perchlorate solutions at 35, 25, and 15°C to be 3.2, 3.5, and 3.7 respectively. The corresponding differences in apparent enthalpies and entropies of dissociation, $\Delta H_{12}-\Delta H_2$ and $\Delta S_{12}-\Delta S_2$, are −1.4 kcal and −2.2 eu, respectively. The ratio was determined to be 4.2 at 0.11 M and 25°C. With the value of the ratio at zero ionic strength, the activity coefficient quotient, Y_2Y_{10}/Y_1Y_{11}, (the subscripts denote the species $H_2PO_4^-$, CrO_4^{2-}, HPO_4^{2-}, and $HCrO_4^-$ in that order) was calculated to be 1.1 and 1.4 at 0.11 and 1 M, respectively. Although the ions are similar in the number of oxygen ligands and in charge, their activity coefficients behaved differently. The concentration equilibrium constant of the second dissociation of chromic acid was calculated from the ratio Q_{12}/Q_2 determined at 0.11 M ionic strength using activity coefficient data and the second dissociation constant of phosphoric acid. At 25°C, Q_2 was approximately 7.4×10^{-7} $molal^{-1}$. (P.C.H.)

24856 (UCRL-6370) NOTES ON GROWING SINGLE CRYSTALS: THE PREPARATION OF SINGLE CRYSTALS OF SOME OF THE TRANSITION METAL FLUORIDES. Edward Catalano and Gilbert S. Stratton (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 7, 1961. Contract W-7405-eng-48. 20p.

Descriptions are given of methods used for the preparation of large single crystals of transition metal halides. The methods are limited to those that are applicable to compounds extremely sensitive to hydrolysis, and to compounds having fairly low vapor pressures at the melting point. A description of a particularly simple apparatus that has proven successful is included. Details of the growth of MnF_2 and CoF_2 single crystals are presented. (auth)

24857 (UCRL-6455-T) THERMODYNAMIC DATA FOR WATER. John C. Howard (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 18, 1961. Contract W-7405-eng-48. 16p.

Thermodynamic data for liquid and gaseous water were compiled and extended to limits of pressure and temperature imposed by Hugoniot, adiabat, and Thomas-Fermi model considerations. The internal energy variation is discussed. (auth)

24858 (WADD-TR-60-359) EXPERIMENTAL STUDIES TO DETERMINE THE CHEMICAL SPECIES PREVALENT IN THE PLASMA OF AN AIR ARC AND THE BOUNDARY LAYERS ADJACENT TO ABLATING MATERIALS. R. Carrigan, E. Raisen, and K. Schmude (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Apr. 29, 1960. Contract AF 33(616)-6686. 57p.

Plasma jets were constructed and operated as sources for optical and time-of-flight mass spectrometry. Optical spectroscopic methods were used to identify chemical species and state of excitation when inert gas or air was used as the plasma arc working medium. Time-of-flight mass spectrometry was not developed to the point where species could be identified. (auth)

24859 (AEC-tr-4649) CALCULATING THE YIELD POINT OF SOLID SOLUTIONS FROM THE PLASTICITY CONDITION FOR SINGLE CRYSTALS. A. Reuss. Translated from Z. angew. Math. u. Mech., 9: 49-58(1929). 14p.

The yield point calculations are made for solid solutions in which it is assumed that the solid is made up of numerous crystals that are small compared with the solid, and that either the stress or deformation tensor is identical throughout the solid. The calculations were made for: the regular system; the hexagonal system; and the triclinic system. Elastic constants were calculated for the quasi-isotropic solid from those of the single crystal. (B.O.G.)

24860 (AEC-tr-4661) THE PREPARATION OF ZINC OXIDE CRYSTALS HAVING DEFINITE ADDITIVES. G. Bogner and E. Mollwo. Translated by C. B. Finch (Oak Ridge National Lab.) from Phys. and Chem. Solids, 6: 136-43(1958). 13p.

A description is given of a refined procedure for preparing zinc oxide crystals from the vapor phase. Stress is placed on the growth of doped crystals containing a controlled amount of additive. Included is a study of the electrical and optical properties of the crystals. (B.O.G.)

24861 (AEC-tr-4756) PHYSICAL-CHEMICAL PROPERTIES OF FLUORINE. E. Wicke and E. U. Franck. Translated for Oak Ridge Gaseous Diffusion Plant from Angew. Chem., 66: 701-10(1954). 50p. (Includes original, 10p.).

The dissociation energy, refractive index, electric polarizability, viscosity, molecular diameter, heat conductivity, and rate of dissociation of fluorine molecules are discussed. A few characteristics of liquid and solid fluorine as well as the electron affinity and the chemical aggressiveness are also discussed. A table is given which compares physical-chemical data for fluorine with that of N_2, O_2, Cl_2, and Br_2. (P.C.H.)

24862 (AERE-Trans-860) THE CATALYTIC OXIDATION OF HYDROCARBONS AS A METHOD FOR THE SYNTHESIS OF MONOMERS. L. Ya. Margolis. Translated by R. W. Hummel for U.K.A.E.A. Atomic Energy Research Establishment from Uspekhi Khim., 28M 615-38 (1959). 53p.

The types of reactions of hydrocarbons with oxygen are given as: direct addition, partial oxidation, destructive oxidation, oxidative condensation, oxidative condensation with inorganic substances, and extensive oxidation with complete destruction of the hycrocarbon skeleton. Examples of each type reaction are included. A review is presented of the various catalysts used in the reactions. The mechanisms of the reactions are discussed. The adsorption of oxygen and hydrocarbon by the oxidation catalysts is described. The kinetics of the oxidation reactions is discussed, and equations are included for the oxidation of several hydrocarbons. 127 references. (B.O.G.)

24863 (AWRE/Trans-19) STUDY OF COMPLEXING-AGENT CHROMATOGRAPHY BY MEANS OF LABELLED ATOMS. 1: THEORETICAL BASES AND ISOTHERM OF Co^{2+} AND Fe^{2+} ION EXCHANGE. S. Yu. Elovich and N. N. Matorina. Translated by F. E. Wallwork for U.K.A.E.A., Atomic Weapons Research Establishment from Zhur. Fiz. Khim. 30, 69-75(1956). 13p.

A discussion is given of the general bases of equilibrium ion-exchange chromatography in stages for cobalt and iron ions. Measurements were made of the isotherms of ion-exchange adsorption of $Co^{++}-H^+$, $Fe^{++}-H^+$, and $Co^{++}-NH_4^+$ on SM-12 cation exchanger with the radioisotopes Fe-59 and Co-60. Values were found for the exchange constants of the systems: $Co^{++}-H^+$, $Fe^{++}-H^+$, $Co^{++}-NH_4^+$, and $NH_4^+-H^+$. The values of the exchange constants with respect to hydrogen were 1.41 and 1.46, respectively for Fe^{++} and Co^{++}, which is in keeping with the slight difference in the diameters of the hydrated ions. (B.O.G.)

24864 (NP-tr-705) DETERMINING THE ENTHALPY AND SPECIFIC HEAT CAPACITY OF BERYLLIUM IN THE INTERVAL 600-2,200°K. P. B. Kantor, R. M. Krasovitskaya, and A. N. Kisel'. Translated from Fiz. Metal. i Metalloved., 10: 835-7(1960). 6p.

Results of the experimental determination of the enthalpy of pure Be in the temperature interval 600-2000°K in the solid and liquid states, and the melting point and heat of transition phase are given. The coefficients of interpolation equations were also determined. (P.C.H.)

24865 CRYSTAL STRUCTURE OF CESIUM URANYL NITRATE. Stjepan S. Malčić and Ljubica M. Manojlović. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 135-9(Mar. 1961). (In English)

Cesium uranyl nitrate was proved to be isomorphous with the corresponding rubidium salt. The crystals appear in two forms: the hexagonal-prismatic and the rhombohedral form. The following unit-cell dimensions were obtained: a = 9.64A and c = 19.51A for the hexagonal lattice and a = 8.56A and α = 68.5° for the rhombohedral one. $D3d-R\bar{3}c$ space group was found, with six and two molecules in the hexagonal and rhombohedral unit-cells, respectively. From

the x-ray-diffraction data the positions of the heavy atoms were determined; the positions of the light atoms were deduced on the basis of symmetry and space considerations. (auth)

24866 MASS SPECTROMETRIC DETERMINATION OF THE SELF-DIFFUSION COEFFICIENT OF BORON TRIFLUORIDE. Kiro F. Zmbov and Živojin V. Knežević. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 141-4(Mar. 1961). (In English)

The self-diffusion coefficient of boron trifluoride was measured with a mass spectrometer. D was estimated to be 0.080 ± 0.002 cm^2 sec^{-1} at 25°C and 0.087 ± 0.001 cm^2 sec^{-1} at 43°C. These values are in good agreement with those calculated on the basis of the Chapman-Enskog kenetic theory of gases, using the Lennard-Jones 12:6 model. (auth)

24867 NOTE ON THE MASS SPECTRA AND STRUCTURE OF THE ALCOXYDIFLUOROBORANES. Kiro F. Zmbov and Slobodan V. Ribnikar. Bull Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 145-53(Mar. 1961). (In English)

The mass spectra of methoxy and ethoxy difluoroboranes are recorded and compared with the mass spectra of methyl and ethyl borates. The spectral patterns indicate a monomeric form $ROBF_2$ in the gas phase. (auth)

24868 EFFECT OF Li_2O AND Ga_2O_3 ADDITIONS ON THE CATALYTIC ACTIVITY OF ZnO and NiO IN THE EXCHANGE REACTION H_2/HDO. Natalija N. Dogramadži and Zorka B. Matić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 155-62(Mar. 1961). (In English)

Catalytic activity of ZnO and NiO in the isotopic exchange reaction $H_2 + HDO \rightleftharpoons HD + H_2O$ in the gas phase was investigated. 1 mole % of Li_2O and Ga_2O_3 were introduced as additions into the lattice of the basic catalyst. Additions were found to affect the catalytic activity. The change in activity depends on the kind of defect occurring in the lattice by introducing cations of various valency. Three stages in forming the active surface have been noticed: the increase in activity, decrease, and the period of constant activity. (auth)

24869 ADSORPTION OF Sr^{++} ION IN PRESENCE OF VARIOUS CATIONS ON THE MONTMORILLONITE-TYPE CLAY. O. M. Gaćinović and O. I. Mićić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 189-97(Mar. 1961). (In English)

The ion exchange between Sr^{2+} and various cations (Na^+, K^+, NH_4^+, Mg^{2+}, Ca^{2+}, Ba^{2+}, respectively) was studied on the clay of the highest capacity among twenty different samples. The exchange has been studied with a view of using clays as adsorption materials for the decontamination of radioactive effluents. Equilibrium constants have been calculated by the static method and at constant total concentration of a 0.1 N solution. At these systems, the order of magnitude of equilibrium constants varies from 1×10^{-1} to 1. Affinities of Ca^{2+} and Sr^{2+} ions on the investigated clay are approximately equal and, accordingly, the equilibrium constant of this system tends to unity. Affinities of cations for clay in presence of Sr^{2+} ion are in the following sequence: $Ba^{2+} > Ca^{2+} > Mg^{2+} > NH_4^+ > K^+ > Na^+$. (auth)

24870 THE DISSOCIATION ENERGIES OF GASEOUS ALKALI HALIDES. Leo Brewer (Univ. of California, Berkeley) and Elizabeth Brackett. Chem. Revs., 61: 425-32(Aug. 1961).

Calculated and experimental values of dissociation energies of gaseous alkali halides are given. The calculation methods are given for both gaseous and condensed halides, and the method used for combining the experimental data is presented. Free-energy functions, internuclear distances, fusion data, heat capacity, entropy, and enthalpy functions are also presented. The data given are for cesium, lithium, potassium, rubidium, sodium, bromine, chlorine, fluorine, and iodine. (N.W.R.)

24871 BEHAVIOR OF RADIONUCLIDES ON ION-EXCHANGE RESINS. Dade W. Moeller (Robert A. Taft Sanitary Engineering Center, Cincinnati), George W. Leddicotte, and Sam A. Reynolds. J. Am. Water Works Assoc., 53: 862-72(July 1961).

A study was made of the behavior of radionuclides on the ion-exchange resins used for decontaminating reactor cooling water. The nuclides were identified in cation, anion, and mixed-bed resin columns with a 20-channel gamma scintillation spectrometer. The results show that in all three columns, the concentration of the radioisotopes on the resin decreased with increasing bed depth. At the same time, the over-all half life of the retained materials simultaneously increased. Considerable variation with depth shows the shorter lived materials predominating near the surface, and the longer lived near the bottom of each column. Thus the removal efficiency of an ion-exchange column is small for long half lives in comparison to their retention time. Breakthrough may occur some time before column saturation, as indicated by the removal of accompanying shorter-lived materials. (N.W.R.)

24872 EMISSION SPECTRA OF THE DOUBLY AND TRIPLY IONIZED RARE EARTHS. G. H. Dieke, H. M. Crosswhite, and B. Dunn (Johns Hopkins Univ., Baltimore). J. Opt. Soc. Am., 51: 820-7(Aug. 1961).

The spectra of the rare earths were photographed under controlled excitation so that either the spectra of the doubly or triply ionized elements are brought out with maximum intensity. A mild excitation is used in addition to give the first and second spectra for comparison. Some regularities are immediately apparent and vary very gradually through the rare-earth group. (auth)

24873 SPECTRAL TRANSMITTANCE PROPERTIES OF RARE-EARTH GLASSES. C. X. Dodd and T. W. West (National Research Council, Ottawa). J. Opt. Soc. Am. 51: 915-16(Aug. 1961).

The effects of temperature variations on the spectral transmittance of several rare-earth glasses are noted. Beams of light were passed through samples containing 5% of the oxides of certain rare earths. Temperatures were varied and it was noted that by increasing the temperature, the transmittance at the maxima was decreased and was increased at the minima. No significant shift in the position of the minima with regard to the wavelength could be observed. (L.N.N.)

Radiation Chemistry and Radiochemistry

24874 (AD-253753) DEVELOPMENT OF RUBBER GASKETS WHICH ARE RESISTANT TO NUCLEAR RADIATION. Final Report. Report No. 149-4. (Mare Island Naval Shipyard. Rubber Lab., Calif.). Feb. 28, 1961. 82p.

Vulcanizates were developed which are suitable for gasket service in gamma radiation up to a dosage of 10^8 r. The rubbers most satisfactory for this purpose are natural rubber, styrene/butadiene copolymers (particularly with 23.5% styrene polymerized at 41°F), and acrylonitrile/butadiene/methacrylic acid terpolymers. The choice of the

rubber to be used depends on the fluid to be sealed. The resistance to radioinduced compression set can be enhanced by compounding the rubbers with antioxidants or antiozonants and/or with certain chemicals containing aromatic rings or condensed ring structures. The resistance of a styrene/butadiene vulcanizate to gamma radiation is improved if dicumyl peroxide is used as the vulcanizing agent in lieu of sulfur. (D.L.C.)

24875 (AERE-R-3706) THE EFFECT OF PILE RADIATION ON THE CARBON DIOXIDE–GRAPHITE REACTION. P. C. Davidge and W. R. Marsh (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1958. Decl. Apr. 1961. 53p.

The effect of pile radiation on the decomposition of carbon dioxide and on the reaction between carbon dioxide and graphite was studied. The apparatus was an all-glass circulation system with a temperature controlled section containing a graphite specimen in the core of the pile. The reaction was followed by analyzing the gas samples for carbon monoxide. In the absence of graphite, slight decomposition of CO_2 to carbon monoxide and oxygen was found. In the presence of graphite the formation of carbon monoxide was greater, no oxygen was found, and the rate of reaction was dependent on the volume of gas irradiated immediately upstream of the graphite. The radiation steady-state carbon monoxide-carbon dioxide composition was approached from CO_2-rich and CO-rich mixtures and, was shown to lie between 0.034 and 0.6% CO in CO_2 at a total pressure of one atmosphere. The results can be accounted for qualitatively if it is assumed that the reaction proceeds through active intermediates formed during the decomposition of CO_2 gas by radiation. Quantitatively, the results depend on geometrical features of the design of apparatus and, in particular, on the arrangement of the graphite sample and pre-irradiated gas volume. (auth)

24876 (ASD-TR-61-170) DETERMINATION OF IRRADIATION PRODUCED TRIPLET EXCITATION BY FLASH SPECTROSCOPY. Period Covered: February 1960 to May 1961. John D. McCollum and W. A. Wilson (American Oil Co. Research and Development Dept., Whiting, Ind.). Contract AF33(616)-7089. 76p.

Triplet excited states accompanying pulsed electron irradiation of solutions of anthracene, phenanthrene, naphthalene, and 9-acetylanthracene were detected by flash absorption spectroscopy. G(triplet) for anthracene is 0.5 for a dose of 10^{18} ev/g and a dose rate of 10^{23} ev/g-sec. Energy transfer from the solvent and subexcitation electron impact appear to be important in triplet formation. Decay rates for the above triplets are of the order 10^3 sec^{-1} in paraffin oil and 10^4 sec^{-1} in cyclohexane and benzene. The first order rate constants increase with dose and temperature. The triplet decay process is interpreted as diffusive free radical quenching by radicals produced simultaneously with triplets during irradiation. The temperature coefficient is due primarily to decrease in solvent viscosity with increasing temperature, thereby increasing diffusion. (auth)

24877 (BNL-602) A REVIEW OF THE UTILIZATION OF FISSION FRAGMENT ENERGY FOR THE FIXATION OF NITROGEN. Meyer Steinberg, J. R. Powell, and Leon Green (Brookhaven National Lab., Upton, N. Y.). Jan. 17, 1961. 72p. (BNL-T-175)

Production of commercial chemicals such as nitrogen tetroxide by direct use of fission fragment energy in large-scale industrial chemo-nuclear processes is discussed. Studies are described on circulating dust, fixed plated, porous bed, and other types of fuels as the basis for chemonuclear reactor designs. Comparisons of fuel systems are given and the chemonuclear process is compared with conventional and other large scale nitrogen fixation methods. Required areas of research for development of such a process are indicated. (J.R.D.)

24878 (CNEN-67) "HOT FACILITIES" OF C.N.E.N., ITALY. A. Cacciari, C. Cesarano, C. Lepscky, and O. Nepi (Italy. Comitato Nazionale per L'Energia Nucleare, Ispra). Mar. 1961. 15p.

An irradiation program is being carried out by the C.N.E.N. Two hot facilities were planned in order to fulfill the requirements of this program. The first one is a high level dismantling facility, and it was obtained from an already existing gamma facility. The second one is a hot laboratory for metallurgic examination of specimens up to 500°C (1 Mev). This facility includes five concrete cells, a small lead brick cell which houses the metallograph, and a low level radiochemistry laboratory. (auth)

24879 (ERDE-16/M/60) THE EFFECT OF HIGH ENERGY RADIATION ON PLASTICS AND RUBBERS: PART 3, POLYURETHANE RUBBER. J. H. Golden and E. A. Hazell (Gt. Brit. Explosives Research and Development Establishment, Waltham Abbey, Essex, England). Aug. 29, 1960. 10p. (AD-252332)

The effects of high-energy electron radiation on the physical properties of an unfilled, cured, polyester urethane rubber, both in air and in vacuum, were studied. The tensile strength and elongation decrease steadily with increasing dose; more rapidly in vacuum than in air. The modulus is little changed by irradiation. Although the over-all effect in both cases is degradation, swelling measurements indicate a greater degree of induced cross-linking in specimens irradiated in vacuum than in those irradiated in air. (auth)

24880 (NAMC-ACEL-442) DECOMPOSITION OF CARBON DIOXIDE WITH HIGH-ENERGY RADIATION. William F. Bingham (Naval Air Material Center, Philadelphia). Feb. 17, 1961. 18p. (AD-253463)

A theoretical treatment is given of the photochemical aspects of CO_2 decomposition with high-energy radiation. The normal surface area needed to effect these reactions with solar energy was calculated to be 2.088×10^4 m^2 with perfect catalysis in order to provide a source of O_2 for one man, indicating that CO_2 decomposition is impractical for use in a manned space vehicle. Experimental results of other workers in this field are reviewed. (D.L.C.)

24881 (TID-7613(p.641-52)) STRONTIUM TITANATE PREPARATION AND SOLUBILITY CHARACTERISTICS. J. G. Morse.

An investigation was made of the potential use of fission-waste Sr^{90} as an energy source in radionuclide-fueled thermoelectric generators. $SrTiO_3$ demonstrated characteristics commensurate with selected criteria for the development of a safe, reliable, contained heat source. The preparation and solubility characteristics of $SrTiO_3$ are reviewed. Data are tabulated. (C.H.)

24882 (TID-7613(p.653-74)) ION-EXCHANGE BEHAVIOR OF VERMICULITE-BIOTITE. Glen R. Frysinger and Henry C. Thomas.

Results are reported from a study of the ion-exchange behavior of vermiculite-biotite when exposed to a solution containing Cs. The sorption of Cs on vermiculite was found to be unaffected by the presence of large amounts of Na but nearly completely blocked when the solution contains appreciable amounts of Al. Results are also reported on the sorptive behavior of Carolina vermiculite when exposed to mixtures of CsCl and $SrCl_2$ in NaCl. Sr^{85}, Na^{22}, and Cs^{134}

were used as tracers. Methods for determinations of the total ion exchange capacity are discussed. (C.H.)

24883 (TID-7613(p.675-90)) CESIUM–SODIUM ION EXCHANGE ON CLINOPTILOLITE. Galen R. Frysinger and Henry C. Thomas.

Results are reported from studies on the ion exchange behavior of Cs and Na ions on clinoptilolite, a natural zeolite mineral which has a high selectivity for Cs. Equilibrium constants for the exchange reaction are calculated from the data presented. (C.H.)

24884 (TID-13331) HOT ATOM CHEMISTRY. John E. Willard (Wisconsin. Univ., Madison). [1961]. 18p.

A summary of the state of knowledge in the field of hot atom chemistry is presented. Selected illustrative examples are included. It is noted that the term hot atom chemistry is often used synonymously with the term chemical effects of nuclear transformations. Included are sections on gas and liquid phase reactions, solid state reactions, and labeling techniques. (J.R.D.)

24885 (AEC-tr-4761) THE RADIOLYSIS OF ORGANIC SUBSTANCES. Jaromir Kučera. Translated from Chem. listý, 54: 764-90(1960). 53p.

The effects of ionizing radiations on organic materials are reviewed. The radiolysis of the following materials in the absence of oxygen is discussed: hydrocarbons, alcohols, ethers, carbonyl compounds, carboxylic acids, acid esters, halogen derivatives, amines and amino acids, and other compounds. The radiolysis of the following materials in the presence of oxygen is described: hydrocarbons, alcohols, ethers, carbonyl compounds, acids, halogen derivatives, and miscellaneous substances. Two hundred and twenty two references are included. (M.C.G.)

24886 (MLM-1101-TR) PROTACTINIUM. M. Haissinsky and G. Bouissieres. Translated by H. W. Kirby for Mound Lab. from p.617-80, Vol. 12, of Nouveau Traite de Chimie Minerale. P. Pascal, ed. (A publication of Masson et Cie, Paris, 1958). 72p.

Discussions are given of the nuclear properties, preparation and purification, and chemical properties of protactinium. Separate bibliographies are included for each section. 163 references. (B.O.G.)

24887 (NP-tr-679) REACTIONS OF CYCLOHEXANE AND OTHER HYDROCARBONS UNDER THE INFLUENCE OF $^{60}Co-\gamma-$RADIATION. D. Hummel and H. Barzynski. Translated by J. H. Waton (U.K.A.E.A., Atomic Energy Research Establishment) from Z. Elektrochemie, 64: 1015-19 (Nov. 1960). 16p. (Includes original, 3p.).

Radicals formed by hydrocarbons under the influence of ionizing radiations react partly with carbon dioxide to form carboxyl and carbonyl compounds. The main part of the reaction products is similar to those formed by the radiolysis of pure hydrocarbons. The reaction proceeds by a single-stage mechanism. The amount of the reaction products depends on the radiochemical instability of the hydrocarbon; thus higher over-all values of G for the reaction are to be found in the case of aliphatic hydrocarbons. The ketones and alcohols detected among the reaction products are possibly formed under the influence of the radiolysis products of carbon dioxide. The reaction products found for cyclohexane were: cyclohexane carboxylic acid (G = 0.19 to 0.34), several other mono- and dicarboxylic acids (G = 0.14 to 0.20), cyclohexanone and cyclohexanol (G = 0.015 to 0.19), dicyclohexyl (G = 0.86 to 0.97) and as main product a slightly oxidized, unsaturated polymeric resin. (auth)

24888 DISSOCIATION OF ETHANOL MOLECULE IONS FORMED IN CHARGE EXCHANGE COLLISIONS WITH POSITIVE IONS. H. Von Koch and E. Lindholm (Royal Inst. of Tech., Stockholm). Arkiv Fysik, 19: 123-46(1961). (In English)

Mass spectra of C_2H_5OH were obtained after charge exchange with slow positive ions. The intensities of the peaks were plotted as a function of the energy absorbed by the molecule during the charge exchange. Integration of these curves gives a mass spectrum in good agreement with that obtained in electron impact. Further, the graph gives experimental information about the dissociation processes in a large molecule ion. Comparison with the corresponding graphs obtained by means of the statistical theory of mass spectra shows disagreement in several respects. The dissociation processes were therefore interpreted without use of this theory. The low intensity of ions formed by loss of H_2O and CH_4 shows that in an electron impact experiment these ions are formed from a highly excited neutral molecule. (auth)

24889 THE EFFECT OF THE RADIOACTIVE EMISSION FROM Y^{90} AND Y^{91} ON THE MAGNITUDE OF THE SOLUBILITY OF YTTRIUM HYDROXIDE. I. Spitsyn and I. E. Zimakov (Inst. of Physics and Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 130-2 (May 1, 1961). (In Russian)

Samples of Y_2O_3 calcined at 950°C were prepared with Y^{90} (E_{max} = 2.18 Mev, $T_{1/2}$ = 64.6 hours) and Y^{91} (E_{max} = 1.55 Mev, $T_{1/2}$ = 57.5 days) tracers with specific activities varying from 0.004 to 260 mc per gram. A sample of 0.5 g Y_2O_3 was mixed with 75 ml of doubly distilled water, and the solubility was followed with time by determining the activity in the solution. At low specific activities of 0.05 to 1.0 mc/g, the solubility of yttrium oxide remains almost constant at 0.17 to 0.18 mg per 100 grams of H_2O. On increasing the specific activity to 20 mc/gram, the solubility drops by a factor of approximately two. There is a sharp increase in solubility starting at a specific activity of 20 mc/g and higher. It is hypothesized that at moderate specific activities (1 to 20 mc/g), positive local charges are formed on the solid Y_2O_3 phase and these positive charges interact with hydroxyl groups to decrease the solubility of yttrium hydroxide in solution. At higher specific activities (>20 mc/g), the ionization is intensified with dissociation of $Y(OH)_3$ molecules so that an increase in solubility is observed. At very low specific activities (<0.1 mc/g), the radioactive tracer has no effect on the solubility of the compound. (TTT)

24890 THE ACTION OF GAMMA IRRADIATION FROM Co^{60} ON THE ISOTOPIC EXCHANGE BETWEEN HYDROCARBON POLYMERS AND GASEOUS DEUTERIUM. Z. S. Bulanovskaya, Ya. M. Varshavskii, V. L. Karpov, and I. Ya. Petrov (Karpov Inst. of Physics and Chemistry, USSR). Doklady Akad. Nauk S.S.S.R., 138: 146-8(May 1, 1961). (In Russian)

The isotopic exchange of deuterium with polyethylene, polymethylmethacrylate and various liquid hydrocarbons was studied as a function of irradiation dose, deuterium pressure, temperature, and surface of the polymer. At a dose of 400 million roentgens and a D_2 pressure of 150 atms, it was found that polyethylene adsorbed 0.55 at.% deuterium, and polymethylmethacrylate absorbed 0.27 at.%. The amount of surface exposed was found to be an important factor, since a polyethylene film 0.3 mm absorbed only 0.45 at.% D_2 as compared with 1.55 at.% D_2 absorption by polyethylene powder. The amount of deuterium absorbed increases almost linearly with dose from 0.2 at.% D_2 at 1×10^8 r to about 0.9 at.% D_2 absorbed at 3×10^8 r. The amount of D_2 absorbed by the polymer increases

rapidly with D_2 pressure up to 2 atm, but the increase in absorption is relatively small above 2 atm D_2 pressure. At a dose of 80×10^6 r and a D_2 pressure of 100 atm, the amount of D_2 absorbed was 0.25 at.% at t = −196°C (liquid nitrogen). On irradiating liquid hydrocarbons, the molecular yield per ev of absorbed energy increased on raising the D_2 pressure from 10 atm to 145 atm at a dose of 2×10^8 r as follows: from 0.8 to 3.9 for n−pentane, from 1.3 to 4.0 for cyclopentane, from 0.8 to 2.2 for n−hexane, from 0.1 to 1.6 for cyclohexane, and from 0.2 to 5.2 for benzene. These isotopic exchange effects with irradiation should be taken into account, when using tracers in biology and chemistry. (TTT)

24891 RADIATION CONVERSIONS OF A MIXTURE OF Fe^{2+} AND Fe^{3+} IN AN ACID SOLUTION SATURATED WITH HYDROGEN UNDER PRESSURE. V. N. Shubin and P. I. Dolin (Inst. of Electrochemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 169-72(May 1, 1961). (In Russian)

The oxidation yields of Fe^{2+} (mol/100 ev) were measured during irradiation with Co^{60} at various concentrations of Fe^{3+} and Fe^{2+} in 0.8 N H_2SO_4. At an H_2 pressure of 100 atm and a concentration of $Fe^{2+} = 1.05 \times 10^{-3}$ M, the oxidation yield (G value) decreased from 5.8 at 10^{-3} M Fe^{3+}, to 4.2 at 2×10^{-3} M, to −1.05 at 8.6×10^{-3} M to −4.2 at 8.6×10^{-2} and −5.8 at 8.6×10^{-1} M Fe^{3+}. The minus sign indicates that reduction is taking place. The ratio of k_1/k_2 for the reactions $H_2 + OH \rightarrow H_2O + H$ (I) and the competing reaction $Fe^{2+} + OH \rightarrow Fe^{3+} + OH^-$ (II) was obtained by plotting the experimental data which is a linear function of $[H_2]/[Fe^{2+}]$. By varying the H_2 pressure, a function which is a linear with respect to $[H_2]/[Fe^{2+}]$ is obtained, and the slope of the plot gives a value of $k_1/k_2 = 0.138$. A ratio of the reaction rates $k_4/k_3 = 9 \times 10^{-3}$ was found for the two competing reactions: $H + Fe^{3+} \rightarrow H^+ + Fe^{2+}$ (III) $H + H^+ \rightarrow H_2^+$ (IV). There is an increase in the oxidation yield with increasing concentration of Fe^{2+} in 10^{-2} M Fe^{3+} at a constant ratio of $[Fe^{2+}]/[H_2]$. It is believed that not all the H_2^+ formed in reaction (IV) reacts with Fe^{2+} at low concentrations, but some H_2^+ is consumed in the reaction: $H_2^+ \rightarrow H^+ + H$. (TTT)

24892 DISSOCIATION OF ADSORBED CO BY SLOW ELECTRONS. George E. Moore (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 32: 1241-51 (July 1961).

Ions emitted from molybdenum and tungsten surfaces in CO when the surfaces are bombarded by electrons were investigated. The surfaces, in the form of ribbons, can be cleaned at will by heating, and bombarded by an electron stream in which current and energy are controlled separately. The product ions are observed in a mass spectrometer whose envelope contains the experimental filament. Electron bombardment liberates only the O^+ ion from adsorbed CO with any abundance; it may be 50 to 100 times more abundant from the surface than from space. No CO^+ or C^+ ions are detected nor any negative ions of CO or its fragments. Carbon atoms remain on the surface. Significant amounts of F^+ and Cl^+ are also liberated from new filaments; these diffuse from the interior and are more tightly bound than CO, and disappear only after prolonged heating. Their surface abundance is so slight that they do not interfere with the O^+ process. The threshold electron energy for liberation of O^+ ions and the dependence of O^+ ion current on electron current and energy are given. The method might be useful for studying kinetics of complex adsorption phenomena, although precautions are necessary to avoid perturbing the adsorbed film by the incoming electrons. The following phenomena are readily observed and probably understood: (a) The growth of a monomolecular film of CO from the ambient following a flash of the filament. (b) Competition for available sites by chlorine, fluorine, carbon, and CO. (c) Poisoning of the surface, for adsorption of CO, by carbon atoms freed by departure of O^+ ions. A simple theory reproduces the experimental kinetics of adsorption and poisoning semiquantitatively. (auth)

24893 IONIZING RADIATION EFFECTS ON POLYMERS. Břetislav Doležel (State Research Inst. for Protective Materials, Prague). Jaderná energie, 7: 196-204(1961). (In Czech)

A survey of ionizing radiation effects on the properties of important polymers is given. The change of chemical structure and physical properties of polyethylene, polyisobutylene, polystyrene, polytetrafluorethylene, polyvinylchloride, polyvinylalcohol, polymethylmethacrylate, polyamides, phenol-formaldehyde resins, melamine-formaldehyde resins, epoxy resins, and natural and synthetic rubber is described. Published data are given through 1958. (tr-auth)

24894 INVESTIGATION OF THE EFFECT OF IONIZING RADIATIONS UPON THE CHEMICAL STRUCTURE OF RUBBER-LIKE FLUORINE COPOLYMERS. A. S. Novikov, V. L. Karpov, F. A. Gali-Ogly, N. A. Slovokhotova, and T. N. Dyumaeva (Karpov Physicochemical Inst., USSR). Vysokomolekulyarnye Soyedineniya, 2: 485-91(1960).

Irradiation in air leads to considerable changes. The intensity of the absorption bands of oxygen-containing groups and of the $-CF=CF_2$ group increases considerably, while the intensity of the C−H, C−F, C−Cl bond stretching vibrations decreases. Herefrom it was concluded that gaseous compounds containing H, F, or Cl were liberated. Fluorine copolymer irradiated in vacuum shows a different spectrum. At small doses (10 to 20×10^6 r), the absorption bands 1640 cm^{-1} (−CH=CF−); 1740 cm^{-1} (−CH=CF_2 or R−CF=CF−R); and 1840 cm^{-1} occur. The latter band is interpreted as belonging to $-CF=CF_2$. At higher doses, instead of the 1740 and 1840 cm^{-1} bands, a broad band with a maximum at 1800 cm^{-1} occurs. This is explained by the formation of cross links at the expense of the double bonds. The considerably decreasing solubility with increasing radiation dose confirms this assumption. An increased content of vinylidenefluoride promotes cross linking. A linear interrelation between cross links and vinylidenefluoride content was found. At the same time destruction occurs, which manifests itself by decreasing viscosity. Thus in the fluorine copolymer the same reactions occur during irradiation as in polyethylene: loosening of C−H bonds accompanied by the formation of free radicals and free hydrogen atoms, which either form compounds with neighboring H, F, or Cl atoms under the formation of double bonds and H_2, HF, or HCl, or take such atoms away from another polymer chain under the formation of a further free radical. The recombination of the free radicals leads to cross linking. With increasing copolymer content, the number of double bonds increases. (OTS)

24895 RADIATION POLYMERISATION OF UNSATURATED ETHERS. Solomon Harris Pinner and Roy Worrall (to T. I. (Group Services) Ltd.). British Patent 873,600. July 26, 1961.

Unsaturated ethers may be polymerized by exposure to high-energy ionizing radiation at −50 to +100°C, either alone or together with solvents or solid substrates such as metal oxides. The products find application in adhesives, tackifying agents, pressure-sensitive tape formulations,

synthetic rubbers, and latex adducts. Examples of the process are given in which various vinyl ethers are polymerized. (D.L.C.)

Raw Materials and Feed Materials

24896 (JEN-87-DMe/I-7) REDUCCION DEL TETRAFLUORURO DE URANIO EN BOMBA CERRADA. PARTE I: ESTUDIO DE LAS VARIABLES GENERALES DEL PROCESO DE REDUCCION. (Uranium Tetrafluoride Reduction in Closed Bomb. Part I: Reduction Process General Conditions). R. Anca Abati and M. Lopez Rodriquez (Spain. Junta de Energia Nuclear, Madrid). 1961. 30p.

General conditions about the metallothermic reduction in small bombs (250 and 800 g of uranium) was investigated. Factors such as kind and granulometry of the magnesium used, magnesium excess, and preheating temperature, which affect yields and metal quality were considered. Magnesium excess increased yields ~15% in small bomb; about the preheating temperature, there is a range between which yields and metal quality do not change. All the tests were made with graphite linings. (auth)

24897 (NLCO-827) ELECTROLYSIS OF MgF_2. William E. Shaw (National Lead Co. of Ohio. Cincinnati). Jan. 6, 1961. Contract AT(30-1)-1156. 69p.

An investigation into the electrolysis of MgF_2 was undertaken in an attempt to recover usable values from MgF_2 slag, a by-product in the production of uranium metal. It was hoped to obtain magnesium metal for use as a reductant of UF_4 and a fluoride value, either HF or F_2, for use in producing UF_4. Since the by-product slag also contained a small amount of uranium, it was hoped to concentrate this value in the cell residue to make its recovery easier. The electrolytic techniques employed were patterned after some now in commercial use. The cell design was originally based on the type used in the electrolysis of $MgCl_2$. A number of anode configurations and anode materials were employed during the tests. The cathode throughout the experiment was the cell crucible. The first electrolyte used was the binary eutectic of MgF_2 and CaF. Later, to obtain a lower melting point, LiF_2 was added to this bath. This ternary eutectic permitted the satisfactory collection of magnesium metal. The anode product, fluorine, generally attacked the anode to form fluorides of the anode material. The use of hydrogen-saturated anodes tended to protect the anode and yielded HF, one of the desired products. Uranium values were concentrated in the cell sludge in early experiments, but in later stages, when convection currents were present, concentration was poor. (auth)

24898 PREPARATION OF PURE METAL FROM THEIR COMPOUNDS. Harvey L. Slatin (to U. S. Atomic Energy Commission). U. S. Patent 2,994,650. Aug. 1, 1961.

A method is described for the preparation of uranium from U_3O_8 by electrolytic deposition at the cathode from an alkali and/or alkaline earth fused salt bath, such as fused strontium potassium chloride. (AEC)

Separation Processes

24899 (BNL-663) REPROCESSING OF REACTOR FUELS BY VOLATILIZATION THROUGH THE USE OF INERT FLUIDIZED BEDS. Status Report. J. J. Reilly, W. H. Regan, E. Wirsing, and L. P. Hatch (Brookhaven National Lab., Upton, N. Y.). May 1961. 19p.

One of the promising methods for recovering uranium and plutonium from reactor fuels is based on the separation of the various components by volatilization. A major problem encountered in this method of reprocessing is the removal of the heat produced by the highly exothermic gas-solid reactions involved. The use of a fluidized bed of inert solids as a heat transfer medium is described in which such reactions may be carried out under controlled conditions. The technique is applied primarily to the recovery of uranium from Navy-type fuels, which are fully enriched fuels of high zirconium content. The procedure, as adapted to this fuel, consists of reacting the zirconium with HCl to form volatile $ZrCl_4$ and subsequent fluorination of the uranium which is recovered as UF_6. In addition, a number of other pertinent reactions were explored, i.e., the fluorination of uranium metal and uranium oxide, the oxidation of uranium carbide, and the chlorination of stainless steel. (auth)

24900 (IDO-10036) NUCLEAR INCIDENT AT THE IDAHO CHEMICAL PROCESSING PLANT ON JANUARY 25, 1961. Report of the Investigating Committee. P. C. Paulus, A. O. Dodd, K. K. Kennedy, F. H. Tingey, and F. M. Warzel (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 1, 1961. 62p.

A nuclear incident involving an enriched U solution occurred in a first cycle product evaporator at the Idaho Chemical Processing Plant, National Reactor Testing Station, at approximately 0950 on January 25, 1961. The reaction resulted from an accidental air lifting of a quantity of solution from a geometrically safe region of the evaporator into the 24-in. diameter vapor disengaging chamber. An energy release of 20 megawatt seconds (6×10^{17} fissions) apparently occurred as a single burst. No significant radiation exposure to personnel, contamination of facilities or environs, property damage, or product loss resulted. Details of events leading to the incident, recommendations, and corrective measures are reported. (auth)

24901 (IDO-14556) SOLVENT EXTRACTION OF ENRICHED URANIUM. D. E. Griffin (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 4, 1956. Decl. Oct. 12, 1960. Contract AT(10-1)-205. 89p.

A compilation of information on solvent extraction including the Hexone-25 process, TBP-25 process is presented. Information is also included on solvent extraction of combined fuels containing Zr and stainless steel compositions. The information was compiled for use in the Reactor Handbook. (J.R.D.)

24902 (NP-10453) TENTATIVE DESIGNS FOR TWO GEOMETRICALLY EVERSAFE MIXER SETTLERS FOR HIGH VOLUMETRIC THROUGHPUTS. C. Hanson and M. J. S. Smith (United Kingdom Atomic Energy Authority. Reactor Group, Risley, Lancs, England). May 5, 1961. 16p. (TRG-Report 22)

The first tentative design described has the stages on top of each other in a vertical slab configuration. This overcomes the lack of driving force but introduces difficulties of construction and stability. The second, a horizontal design, uses a marine propeller to maintain a large difference in surface level between the mixer and settling compartments. This way unlimited driving force and complete hydraulic stage independence is achieved. The liquors flow from the settling compartments over weirs which eliminate back-mixing. The unit is simple, flexible, and provides ideal settling conditions. Small models of each of these designs were run successfully. It is recommended that the second be developed. (auth)

24903 (NYO-9581) ULTRASONIC LEACHING OF URANIA-IMPREGNATED GRAPHITE FUELS. William B.

Tarpley and Robert S. Winchester (Aeroprojects, Inc., West Chester, Penna.). Apr. 1961. Contract AT(30-1)-1836. 18p.

The proposed use of unclad, urania-impregnated graphite fuel elements in experimental and power reactors raised the question of how best to reprocess the elements after irradiation. A grind-leach process using boiling nitric acid was previously suggested as alternate to earlier combustion techniques. Besides requiring pre-grinding of the elements the process did not leave a residue sufficiently low in radioactivity when the elements contained initially less than 3 wt % uranium. Application of ultrasonic vibratory energy to the graphite during this process increased leaching rate and completeness to such an extent that the practical process limit of 3% uranium is no longer a problem. The ultrasonic studies were carried out with non-irradiated specimen plates and ground pebble specimens. The plates apparently can be leached in practical time span to such a low level of radioactivity that disposal of the graphite residues is simplified. Furthermore it appears that the pre-grinding of the spent elements can be eliminated. Direct activation of the intact fuel plate specimens resulted in leaching efficiency at least as good as with ground specimens. (auth)

24904 (ORNL-3068) AQUEOUS PROCESSES FOR DISSOLUTION OF URANIUM–MOLYBDENUM ALLOY REACTOR FUEL ELEMENTS. L. M. Ferris (Oak Ridge National Lab., Tenn.). July 14, 1961. Contract W-7405-eng-26. 39p.

Methods for dissolving unirradiated uranium-molybdenum alloy reactor fuels in nitric acid, nitric acid–ferric nitrate, and nitric acid–phosphoric acid solutions were studied on a laboratory scale. Flowsheets based on the results propose dissolution of alloys containing 3% molybdenum in boiling 6 M HNO_3 to yield stable solutions that are 0.6 M in uranium and 3 to 4 M in nitric acid. The uranium can then be easily decontaminated and recovered in a conventional Purex-type tributyl phosphate solvent extraction process. Alloys containing 10% molybdenum would be dissolved in boiling 11 M HNO_3, allowing molybdic oxide to precipitate. The molybdic oxide, which carries 5-10% of the uranium, is removed by centrifugation and the acidity of the supernatant solution adjusted to allow recovery of the uranium by Purex-type solvent extraction procedures. The uranium carried by the molybdic oxide is recovered after the MoO_3 is dissolved in warm 5 M NaOH. Less than 0.1% of the uranium is solubilized during the caustic dissolution. Alternative methods investigated involve dissolution in nitric acid containing 0.5 to 1 M ferric nitrate to complex the molybdenum. These techniques lead to undesirably large volumes of high-level solvent extraction waste solutions. Phosphate ion is also effective in complexing molybdenum; however, its use in the dissolvent would be purposeless since it must be complexed with iron during solvent extraction. Rates of reaction of the various alloys and the solubility of molybdic oxide were determined in nitric acid, nitric acid–ferric nitrate, and nitric acid–phosphoric acid solutions. (auth)

24905 (ORNL-3142) FUEL CYCLE DEVELOPMENT. Semiannual Progress Report for Period Ending March 31, 1961. D. E. Ferguson (Oak Ridge National Lab., Tenn.). July 27, 1961. Contract W-7405-eng-26. 32p.

Flowsheet conditions for the sol-gel process were further optimized to improve the quality of the product and simplify the process. Using the improved procedure, a mixed oxide containing enriched uranium was prepared which consistently vibratorily compacted to 8.7 g/cc in short 0.25-in.-diam tubes. Eight such tubes were inserted in the NRX reactor where they are now under irradiation at an estimated heat flux of 370,000 Btu/hr/ft^2. The rate of fission gas release from sol-gel mixed ThO_2–UO_2 was measured. For this oxide the rate of xenon release was diffusion controlled up to about 2200°C, where sublimation appears to start. This change in mechanism of release occurs at about 1800°C for UO_2; otherwise the release rates appear qualitatively the same for both oxides. Increasing the time of vibratory compaction from 10 min to 1 hr resulted in an increase of only 1% in final packed density. Adding a 0.4-lb load to the top of the oxide in the tube increased the final compacted density by another 1.5%. Studies of mixed oxide samples were made to determine the number of phases present, the O/U ratio, unit cell sizes, refraction index, and homogeneity. An apparatus was constructed and calibrated to determine the area of stability for the fluorite phase by measuring dissociation pressures of the solid solutions of ThO_2 and UO_2. (auth)

24906 (AEC-tr-4057(p.342-9)) PRODUCTION OF Re^{188} WITHOUT A CARRIER BY A METHOD BASED ON DISRUPTION OF CHEMICAL BONDS DURING β-DECAY. V. D. Nefedov and M. A. Toropova. Translated from Zhur. Neorg. Khim., 2: 1667-71(1957).

A method for the rapid isolation of Re^{188} from neutron-irradiated $W(CO)_6$ without a carrier is described. The retention of Re^{188} observed in solid $W(CO)_6$ is probably due to synthesis of $Re(CO)_5$. (D.L.C.)

24907 PARTITION OF NITRIC ACID BETWEEN WATER AND SOME BINARY ORGANIC MIXTURES. Z. Dizdar and J. Rajnvajn. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 181-8(Mar. 1961). (In English)

The partition of nitric acid between water and binary mixtures of organic solvents, one component of which has always been TBP, the other DBE, MIK, or AA, has been investigated. The distribution coefficients in all three investigated systems are found between the distribution coefficients of pure solvents. The partition curves for various organic phase composition were found in all three cases to intersect at defined high acidity of aqueous phase. Some interesting facts result from this: a) in each investigated system there is a defined acidity of the aqueous phase (at equilibrium), where the distribution coefficient of nitric acid has constant value regardless of the organic phase composition; b) with a defined organic phase composition, the distribution coefficient has in each investigated system a constant value regardless of the aqueous phase acidity. In TBP-DBE system, the distribution coefficient attains this constant value at 33 mol % TBP, while in systems with TBP-AA and TBP-MIK it is attained at 25 mol % TBP. (auth)

24908 CONTINUOUS ION EXCHANGE EQUIPMENT ADAPTED TO WATER AND DILUTE WASTE TREATMENT. Irwin R. Higgins (Chemical Separations Corp., Oak Ridge, Tenn.). Ind. Eng. Chem., 53: 635-7(Aug. 1961).

The operating characteristics and advantages of the Higgins continuous countercurrent solid-liquid contactor are discussed with emphasis on equipment with high throughput rate per unit size for water and dilute waste treatment. The contaminants usually exhibit high distribution coefficients for the ion exchange resin, but because they are dilute it is desirable to contact very rapidly. Continuous water softening is demonstrated at 100 gallons per minute per square foot. High production rates and stoichiometric regeneration are demonstrated for demineralizing bicarbonate water using weak acid resin. The successful handling of lime slurry re-

generation is demonstrated, promising possible lower cost water treatment. A study of alkaline radioactive waste treatment is made, using continuous ion exchange with phenolic cation exchange resin. (auth)

24909 SEPARATION OF STRONTIUM-90 FROM CALCIUM BY SOLVENT EXTRACTION. R. E. McHenry and J. C. Posey (Oak Ridge National Lab., Tenn.). Ind. Eng. Chem., 53: 647-50(Aug., 1961).

To produce high purity strontium-90 from irradiated uranium reprocessing waste solutions, a process is developed to separate strontium from calcium. This is done by use of a solvent extraction process using D2EHPA in Amsco as the extractant. Several flowsheets are demonstrated. The processes use an acetic acid-acetate buffered aqueous phase which is countercurrently contacted in an 11-stage mixer-settler with a D2EHPA-Amsco organic phase. An alcohol (2-ethylhexanol) is added to the organic phase to reduce distribution coefficients and to reduce the effect of organic phase loading on distribution coefficients. Calcium and strontium enter the process as acetates. A product containing more than 99% of the strontium and no calcium, within analytical error, is produced from a feed solution containing a 20-fold excess by weight of calcium. (auth)

24910 SOLVENT EXTRACTION SEPARATION OF CERIUM AND YTTRIUM FROM OTHER RARE EARTH FISSION PRODUCTS. T. A. Butler and E. E. Ketchen (Oak Ridge National Lab., Tenn.). Ind. Eng. Chem., 53: 651-4(Aug. 1961).

A batch solvent extraction process was developed to separate Y^{91} and Ce^{144} from the rare-earth fission product elements in HNO_3 solution by extraction into a di(2-ethylhexyl)phosphoric acid organic phase. Yttrium is first extracted from a 1N HNO_3 solution into the organic phase. Cerium is oxidized by $KMnO_4$ to the tetravalent state prior to its removal by a second batch extraction. A Ce^{144} product is recovered from the organic phase by back extraction as the trivalent ion into a H_2O_2–HNO_3 aqueous phase. The remaining rare earths contain Pm^{147} which can be separated and recovered by conventional ion exchange techniques. The process was demonstrated in a pilot plant run from which 129,000 curies of high-purity Ce^{144} was recovered in good yield. (auth)

24911 EXTRACTION OF URANIUM, PLUTONIUM, RUTHENIUM, AND ZIRCONIUM WITH TRIISOOCTYLAMINE. Werner Knoch (Tekniska Högskola, Goteborg). Z. Naturforsch., 16a: 525-7(May 1961). (In German)

The distribution coefficients K_d for uranium, plutonium, ruthenium, and zirconium between triisooctylamine and the aqueous phase were investigated as a function of HNO_3 activity, amine concentration, uranium concentration, and the concentration of the salting agent $Al(NO_3)_3$. The system 20% triisooctylamine–kerosene/U, Ru(NO) in 6 M HNO_3 was subjected to continuous counter-current extraction. The extraction conditions and the distribution data in 8 stages of the mixer-settler apparatus are given. (J.S.R.)

24912 REACTOR HANDBOOK. SECOND EDITION, REVISED AND ENLARGED. VOLUME II. FUEL REPROCESSING. S. M. Stoller and R. B. Richards, ed. New York, Interscience Publishers, Inc., 1961. 677p.

A compilation is given of data accumulated on the aqueous and nonaqueous separation processes, reconversions, radioactive waste disposal, plant and equipment design, and plant management. Emphasis is placed in correlating the data with the reference. (B.O.G.)

24913 RECOVERY OF PLUTONIUM BY CARRIER PRECIPITATION. R. H. Goeckermann (to U. S. Atomic Energy Commission). U. S. Patent 2,978,295. Apr. 4,1961.

The recovery of plutonium from an aqueous nitric acid Zr-containing solution of 0.2 to 1N acidity is accomplished by adding fluoride anions (1.5 to 5 mg/l), and precipitating the Pu with an excess of H_2O_2 at 53 to 65°C. (AEC)

24914 METHOD OF REMOVING IODINE FROM GASES AND FILTER MEDIUM THEREFOR. L. Silverman (to U. S. Atomic Energy Commission). U. S. Patent 2,994,577. Aug. 1, 1961.

A method for the removal of iodine from large gas volumes is described. The gaseous medium is heated to a temperature not exceeding 400°C. Water vapor is then added to the medium in approximate amounts of 1 lb/cu ft of the medium. The medium is then passed through a porous copper fibrous pad having deposited thereon a coating of silver, the silver coating being treated with hydrogen sulfide forming a layer of silver sulfide. (AEC)

24915 DISSOLUTION OF A CERIUM-TYPE PLUTONIUM-CONTAINING FLUORIDE CARRIER. Arthur C. Wahl (to U. S. Atomic Energy Commission). U. S. Patent 2,994,579. Aug. 1, 1961.

The dissolution of a plutonium-containing lanthanum or cerous fluoride carrier precipitate by means of an aqueous, preferably acid, solution of ferric ions is described. (AEC)

24916 METHOD FOR DISSOLVING LANTHANUM FLUORIDE CARRIER FOR PLUTONIUM. D. E. Koshland, Jr. and J. E. Willard (to U. S. Atomic Energy Commission). U. S. Patent 2,995,419. Aug. 8, 1961.

A method is described for dissolving lanthanum fluoride precipitates which is applicable to lanthanum fluoride carrier precipitation processes for recovery of plutonium values from aqueous solutions. The lanthanum fluoride precipitate is contacted with an aqueous acidic solution containing dissolved zirconium in the tetravalent oxidation state. The presence of the zirconium increases the lanthanum fluoride dissolved and makes any tetravalent plutonium present more readily oxidizable to the hexavalent state. (AEC)

24917 EXTRACTION OF TETRAVALENT PLUTONIUM VALUES WITH METHYL ETHYL KETONE, METHYL ISOBUTYL KETONE ACETOPHENONE OR MENTHONE. Glenn T. Seaborg (to U. S. Atomic Energy Commission). U. S. Patent 2,995,588. Aug. 8, 1961.

A process is described for extracting tetravalent plutonium from an aqueous acid solution with methyl ethyl ketone, methyl isobutyl ketone, or acetophenone and with the extraction of either tetravalent or hexavalent plutonium into menthone. (AEC)

24918 EXTRACTION OF TETRAVALENT PLUTONIUM VALUES FROM AQUEOUS ACID SOLUTIONS BY 2(β-ETHYLBUTOXY) ETHANOL. Glenn T. Seaborg (to U. S. Atomic Energy Commission). U. S. Patent 2,996,526. Aug. 15, 1961.

A process of extracting tetravalent plutonium from aqueous inorganic acid solutions (acidity between 1 N and pH of 2.5) with 2(β-ethylbutoxy) ethanol is described. (AEC)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

24919 (CF-61-6-112) VAPOR SOLUTION AND CONDENSATION IN MECHANICAL VACUUM PUMP OILS. Frank A. Knox (Oak Ridge National Lab., Tenn.). June 14, 1961. 15p.

A review of various methods for prevention of vapor contamination in mechanical vacuum pump oils is presented. Experience with the air stripping method at ORNL for the past sixteen years is discussed, and general rules for the determination of the methods to be used in any situation are given. (auth)

24920 (EOS-310-Final) RADIATOR-CONDENSER FOR SPACE ENVIRONMENT. Alan M. Haire, Lance G. Hays, and Joseph L. Collins (Electro-Optical Systems, Inc., Pasadena, Calif.). Oct. 31, 1960. Contract AF 33 (616)-6520. 325p. (WADD TR 61-20; AD-253791)

A radiator-condenser (R-C) for a Rankine cycle space power system was designed to condense and subcool superheated mercury vapor. The weight of the R-C was to be minimized at design conditions. The design incorporated curved stainless steel tubes welded to tapered stainless steel manifolds and brazed to a steel radiation fin. A test model R-C, designed to reject approximately 1 kw of heat, was tested in a closed loop laboratory system over a range of vapor inlet temperatures from 810 to 964°F. Both wet and superheated vapor conditions were used. Flow rates were adjusted over a range of values at each inlet temperature in order to move the vapor-liquid interface from a position near the R-C outlet manifold to a position near the inlet manifold. The results demonstrated that a curved tube R-C can be used to condense mercury vapor in a space power system over a relatively wide range of operating conditions. For the range covered in the present investigation, vapor-free liquid flow was obtained at the R-C outlet, and relatively stable conditions occurred in the R-C. Performance of the R-C demonstrated the validity of the design method, except that measured pressure drops were considerably lower than those predicted by currently available analytical methods. All aspects of the present investigation are summarized. The design procedure is given along with fabrication and experimental details. In addition, state-of-the-art information obtained during the early phases of the investigation is included. Experience derived from operation of the experimental test loop is reported. Limitations of the data, along with problems which require further investigation, are also noted. (auth)

24921 (JEN-88-DF/I-27) BANCO DE PRUEBAS PORTATIL PARA EL ESTUDIO DE FUENTES DE IONES Y DE LA EXTRACTION Y ENFOQUE DEL HAZ DE IONES. (Portable Test Bench for Studies Concerning Ion Sources and Ion Beam Extraction and Focusing Systems). F. Cordero Lopez (Spain. Junta de Energia Nuclear, Madrid). 1961. 12p.

A portable test bench is described, which was designed to check ion sources, and ion beam extraction and focusing systems before use in a 600 kev Cockcroft-Walton accelerator. The vaccum possibilities of the system are analyzed in connection with its particular use. The whole can be considered as a portable accelerator of low energy, 50 kev. (auth)

24922 (TID-4100(1st Rev., Suppl. 12)) SUPPLEMENTAL INSERT SHEETS FOR ENGINEERING MATERIAL LIST. Richard E. C. Duthie (Office of Technical Information Extension, AEC). June 1961. 82p.

Lists of engineering materials including hot laboratory equipment, instruments, metallurgical equipment and processes, nuclear radiation instruments, nuclear reactors and facilities, plant designs and processes (chemical), particle accelerators, and rockets and missiles are presented. (M.C.G.)

24923 (TID-6814) MERCURY PUMP DESIGN. THE SNAP II POWER CONVERSION SYSTEM TOPICAL REPORT NO. 5. M. A. Keresman (Thompson Ramo Wooldridge Inc., Cleveland). June 10, 1960. Contract AT(11-1)-GEN-8. 79p. (ER-4101)

Design details and test results of the jet-centrifugal mercury pump are presented. (auth)

24924 (TID-13103) VARIATION WITH SIZE OF CHARACTERISTICS OF ELECTRIC CIRCUIT COMPONENTS HAVING GAIN. Report No. 109 (Thesis). John L. Muerle (Illinois. Univ., Urbana. Digital Computer Lab.). May 19, 1961. 121p.

Considerations are given for the reduction in size of a cryotron, a field emission tube, and magnetic film component. The variation with size, as size is reduced, of the electrical characteristics of the components having gain was determined. Comments are included on the limitations of size reduction in relation to the electrical characteristics of the components under consideration. (B.O.G.)

24925 (WADC-TR-59-751(Suppl. 1)) HANDBOOK FOR HYDROGEN HANDLING EQUIPMENT. A. W. Adkins, I. A. Black, R. W. Byrnes, A. A. Fowle, F. Gabron, F. E. Ruccia, and R. W. Breckenridge, Jr. Little (Arthur D.) Inc., Cambridge, Mass.). May 1961. Contract AF 33(616)-7330.

The results are given of investigations in five technical areas pertaining to the handling of large quantities of liquid hydrogen. The current availability and specifications are established for liquid hydrogen pumps and the operational experience reported by the major users of these items is cited. A tested method is described for predicting the hydrogen gas required for the pressurized transfer of liquid hydrogen. The known facts are recounted which relate to the safety and reliability of hydrogen gas cylinders as used in typical operations for the pressurized transfer of liquid hydrogen. The design specifications and performance characteristics are presented of gravity-fed and boosted pressure-fed vaporizers for liquid hydrogen transfers established as a result of an integrated program of theoretical analysis and tests. An economic comparison is included of systems using pumps, hydrogen vaporizers and high-pressure hydrogen gas bottles to transfer liquid hydrogen. This work represents a refinement or up-dating of that originally presented in Chapter 3 of the Handbook for Hydrogen Handling Equipment. The results are presented of a further investigation of the single parting line coupling for vacuum-jacketed transfer lines. A modified design and its performance characteristics established from tests are included. (auth)

24926 A PUMP FOR PUMPING MOLTEN LOW-MELTING METALS AND SALTS. A. I. Noskov and D. V. Gorshkov. Byull. Izobretnii, No. 16, 37(1960).

This pump is made of a hollow body and a shaft with two helical worms, right- and left-hand, and is designed to

achieve normal working at a high revolution speed without lubrication. The bearings are made of hard alloys. (OTS)

24927 HYDROMAGNET: A SELF-GENERATING LIQUID CONDUCTOR ELECTROMAGNET. Henry H. Kolm (M. I. T. National Magnet Lab., Cambridge, Mass., and M. I. T. Lincoln Lab., Lexington, Mass.), and Osman K. Mawardi. J. Appl. Phys., 32: 1296-1304(July 1961).

A novel liquid electromagnet is investigated in which the exciting current is generated within the solenoid by forcing the liquid conductor radially inward through the space between two coaxial cylinders placed in an axial magnetic field. The tangential current thus generated within the flowing conductor adds to the initial applied field so that the device behaves like a self-excited, short-circuited homopolar generator. It is shown theoretically that for low values of the magnetic Reynolds number, the amplification of the magnetic field is a quadratic function of this number and that the total dissipation depends on the square of the amplification and on the cube of the hydrodynamic Reynolds number. The experimental findings are in reasonable agreement with the theory. (auth)

24928 PNEUMATIC CONVEYANCE AND DOSAGE OF RADIOACTIVE SOLUTIONS ON A LABORATORY SCALE. Heinz Scholz (Kernreaktor Bau- und Betriebsgesellschaft, Karlsruhe, Ger.). Kerntechnik, 3: 261-3(June 1961). (In German)

Since dosage pumps are unsuitable for small quantities of liquids and for radioactive solutions, a pneumatic dosage pump on the laboratory scale was developed. Contrary to previous ideas, it was found that even very small quantities of liquids can be conveyed pneumatically with good reproducibility. (auth)

24929 APPARATUS FOR AUTOMATIC TREATMENT OF PHOTOGRAPHS OBTAINED FROM BUBBLE CHAMBERS. E. M. Andrejev, P. Hirsl, G. M. Kadikov, S. M. Korenchenko, V. M. Lachinov, A. G. Morozov, K. G. Nekrasov, R. Pose, M. I. Popov, V. V. Smirnov, N. S. Tolstoj, and I. A. Zarubin (Joint Inst. for Nuclear Research, Dubna, USSR). Nuclear Instr. & Methods, 11: 297-306(May 1961). (In English)

An automatic apparatus is described that is designed to scan the coordinates of particle tracks on photographs taken from bubble chambers. The accuracy of the coordinate measurements on the film is 2 to 4 microns. The tracking velocity over the film is 3 mm/sec. The coordinate readings are punched on perforated tape, and they may be fed into electronic computers for further mathematical treatment. (auth)

24930 TEMPERATURE MEASUREMENT IN ENGINEERING. VOLUME II. H. Dean Baker, E. A. Ryder, and N. H. Baker. New York, John Wiley & Sons, Inc., 1961. 517p. $13.00.

The applications, designs, and problems of the resistance thermometer and the radiation pyrometer are presented. Concrete examples are given of successful techniques worked out to perform measurements in cases ranging from the interior of the human body to interstellar space, the immediate vicinity of absolute zero to the internal temperature of stars, or the temperatures in rotors of ultracentrifuges to those in precision thermostats, flames, and explosions. (N.W.R.)

24931 COMBUSTION AND PROPULSION. FOURTH AGARD COLLOQUIUM, MILAN, APRIL 4-8, 1960. HIGH MACH NUMBER AIRBREATHING ENGINES. A. L. Jaumotte, A. H. Lefebvre, and A. M. Rothrock, eds. New York, Pergamon Press, 1961. 408p. $15.00.

Thirteen papers are included on the progressive development of the hypersonic airplane and its engines. The uses, policies, and problems of hypersonic aircraft are discussed. The propulsion systems are discussed in terms of research and development problems and possible means for finding solutions to these problems. Some of the problems of ramjet and turbojet engines discussed include nozzle flow with chemical reactions, diffusion flames, detonation waves, high temperature material limitations, and hypersonic inlet designs. (N.W.R.)

24932 1960 SEVENTH NATIONAL SYMPOSIUM ON VACUUM TECHNOLOGY TRANSACTIONS, OCTOBER 12-14, SHERATON CLEVELAND HOTEL, CLEVELAND, OHIO. C. Robert Meissner, [ed.]. New York, Pergamon Press, 1961. 446p. $20.00.

Seventy papers are included on such topics as vacuum system components, vacuum measuring techniques, pressure measurements—their apparatus and techniques, vacuum systems, industrial and metallurgical applications of vacuum, vacuum system applications, thin films, pumping mechanisms, and partial pressure measuring devices. (N.W.R.)

24933 IMPROVEMENTS IN OR RELATING TO SLOW-RELEASE COUPLING DEVICES. William Joseph Sidebottom and Leslie Maurice Fletcher (to United Kingdom Atomic Energy Authority). British Patent 873,387. July 26, 1961.

A slow-release coupling device for connecting two members is described which is uncoupled by slow movement of one of the members relative to the other but not by a sudden transient force. The device has an application in certain apparatus in gas-cooled reactors where transient pressure surges of coolant gas may occur. (D.L.C.)

24934 REMOTE-CONTROLLED MANIPULATING APPARATUS FOR MANIPULATING OBJECTS INSIDE SEALED CHAMBERS. (to Commissariat a l'Energie Atomique). British Patent 873,441. July 26, 1961.

A telemanipulator for manipulating objects inside a sealed chamber is designed which does not necessitate the creation of openings in the chamber walls. The apparatus comprises a first group of control units outside the chamber which actuates a second group of corresponding operating units inside the chamber. The connection between the groups is made by magnets superimposed on opposite sides of the chamber. (D.L.C.)

24935 IMPROVEMENTS IN OR RELATING TO UNDERWATER LIGHTING ASSEMBLIES. William Marshall Sherrington, Thomas Henry Morrison, Donald Robert Russell Fair, and Kenneth Prince (to United Kingdom Atomic Energy Authority). British Patent 873,458. July 26, 1961.

An underwater lighting assembly is designed for illuminating irradiated objects in water. The assembly comprises an array of neck-sealed electric lamps carried in an open structure and provided with a light transmitting cover strengthened to support objects above the lamps. In operation, the assembly rests on the tank floor with the light aimed upward, and submerged objects are silhouetted by the light. (D.L.C.)

24936 GAS-IONISING APPARATUS FOR USE IN ELECTROSTATIC PRECIPITATORS. (to Societe Financiere d'Expansion Commerciale et Industrielle -S.A. "Sfindex"). British Patent 873,565. July 26, 1961.

A gas-ionizing apparatus for electrostatic precipitators is designed so that high field strengths of $\sim 10^6$ v/cm can be attained with voltages less than 6 kv, resulting in very high ion velocities without production of ozone and nitrous gases.

The apparatus comprises a first electrode in the form of a tube and a second electrode having a pointed end within the tube. The pointed end is pointed toward one end of the tube but is nearer to the other end and has a dome-shaped tip of radius less than 10^{-5} cm. Ionization can also be enhanced by applying a minimum quantity (a few atoms) of Tl^{204}, a β radiator, to the dome-shaped tip. (D.L.C.)

24937 MOLECULAR VACUUM PUMP. E. E. Eckberg (to U. S. Atomic Energy Commission). U. S. Patent 2,954,157. Sept. 27, 1960.

A multiple molecular vacuum pump capable of producing a vacuum of the order of 10^{-9} mm Hg is described. The pump comprises a casing of an aggregate of paired and matched cylindrical plates, a recessed portion on one face of each plate concentrically positioned formed by a radially extending wall and matching the similarly recessed portion of its twin plate of that pair of plates and for all paired and matched plates; a plurality of grooves formed in the radially extending walls of each and all recesses progressing in a spiral manner from their respective starting points out at the periphery of the recess inwardly to the central area; a plurality of rotors rotatably mounted to closely occupy the spaces as presented by the paired and matched recesses between all paired plates; a hollowed drive-shaft perforated at points adjacent to the termini of all spiral grooves; inlet ports at the starting points of all grooves and through all plates at common points to each respectively; and a common outlet passage presented by the hollow portion of the perforated hollowed drive-shaft of the molecular pump. (AEC)

24938 MODIFIED BALL AND SOCKET COUPLING. D. D. Kalen (to U. S. Atomic Energy Commission). U. S. Patent 2,984,995. May 23, 1961.

A ball and socket coupling arrangement is described in which the male and female members may be engaged or disengaged without visual aid. The female member has an internal spherical seat through which slots are provided to accommodate appropriately arranged and shaped ribs in the ball member. After engagement of the members, one or both are rotated to lock them together to prevent accidental disengagement. (AEC)

24939 REMOTELY OPERATED MANIPULATOR. E. L. Hutto (to U. S. Atomic Energy Commission). U. S. Patent 2,996,330. Aug. 15, 1961.

A manipulator is described for performing, within an entirely enclosed cell containing radioactive materials, various mechanical operations. A rod with flexible fingers is encompassed by a tubular sleeve shorter than the rod. Relative movement between the rod and sleeve causes the fingers to open and close. This relative movement is effected by relative movement of permanent magnets in magnetic coupling relation to magnetic followers affixed to the ends of the rod and sleeve. The rod and its sleeve may be moved as a unit axially or may be rotated by means of the magnetic couplings. The manipulator is enclosed within a tubular member which is flexibly sealed to an opening in the cell. (AEC)

Heat Transfer and Fluid Flow

24940 (ARF-1167-12) FEASIBILITY STUDY OF A NEW MASS FLOW SYSTEM. Quarterly Report No. 4, March 1, 1961 to May 31, 1961. J. W. Haffner (Illinois Inst. of Tech., Chicago. Armour Research Foundation). June 23, 1961. Contract AT(11-1)-578. 32p.

Activities are reported on development work on a mass flow system capable of measuring externally the properties of homogeneous flow, slurries, highly corrosive fluids, and multi-phase fluids. In the proposed system, the fluid passes through an S-shaped tube wherein measurements of the angular momentum and density yield mass flow directly. (B.O.G.)

24941 (BM-RI-5812) PROBLEMS IN RECOVERING THERMAL ENERGY FROM MOLTEN SALTS. T. A. Henrie (Bureau of Mines. Reno Metallurgical Research Center, Nev.), R. A. Renner and R. L. Olson (California. Univ., Livermore. Lawrence Radiation Lab.), and O. Q. Leone and D. H. Baker, Jr. (Bureau of Mines. Boulder City Metallurgy Research Lab., Nev.). Sept. 1960. 31p.

A study was conducted to determine the problems involved in recovery of thermal energy from molten salts. The study was conducted in connection with project Gnome which will be conducted in an underground salt deposit to determine the feasibility of recovering thermal energy from underground nuclear explosions. (J.R.D.)

24942 (CF-61-5-80) THERMAL ANALYSIS OF CONICAL SHELLS. F. J. Witt (Oak Ridge National Lab., Tenn.). July 7, 1961. 28p.

The differential equation of a conical shell subjected to axisymmetrical temperature distributions is derived. The temperature distribution may vary in the meridional direction and linearly through the thickness, and, in order to obtain a particular solution to the differential equation, the expression for the temperature distribution is assumed to be the sum of a hyperbolic and a cubic function. The particular solution is superposed on the general solution for pressure and axial loading. All the formulas for a complete analysis are given and an example is solved. Approximating an exponential temperature function by the function described above is discussed. (auth)

24943 (DP-583) FRICTION FACTORS FOR FLOW OF WATER IN AN ANNULUS WITH ONE ROUGHENED WALL. W. S. Durant (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). June 1961. Contract AT(07-2)-1. 21p.

Friction factors were determined for water flowing in an annulus with the inner wall roughened. The inner wall was the outer surface of a ½-inch-OD tube, the roughness consisted of medium-diamond knurls, and the annulus thickness was varied from 0.15 to 0.25 inch. The data are correlated by the equation: $(1/\sqrt{f}) = (Re)^{0.14} \ln \sqrt{(D_e/\epsilon)} + [29/(Re)^{0.20}]$, where f is the Fanning friction factor, Re is the Reynolds number, ϵ is the knurl depth, and D_e is the equivalent diameter of the annulus. An approximate method was developed for extending the correlation to cases where the fraction of the wetted perimeter roughened is outside the range covered by the measurements. (auth)

24944 (GEAP-3493(Rev.I)) THE STABILITY OF TWO-PHASE FLOW LOOPS AND RESPONSE TO SHIP'S MOTION. E. S. Beckjord (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Sept. 26, 1960. Contract AT(04-3)-189. 50p.

Investigations were made to determine the dynamics of stationary two-phase flow loops and of those accelerated by ship's motion, and the controlling parameters. The results apply to boiling water reactors, and enable prediction and design of stable two-phase flow in reactors. An analogue computer circuit is developed for calculating loop transients. Analytical predictions of stability and transient response are compared with A.P.E.D. Heat Transfer Loop test results. Analogue computations were made of the effect on the T-7 core of a 20% of normal gravitational acceleration increase, and of the effect of a 20% heating in-

crease in channel 1 of 2 coupled parallel channels similar to T-7 core channels. Conclusions drawn on the factors which determine loop dynamics are: 1. The natural period of the loop is governed by the transit time of fluid across the two-phase vertical section. If oscillatory, the period will be between 4/3 T and 2 T, where T is the transit time; 2. The primary cause of loop instability is subcooling with high steam voids, because subcooling makes the natural circulation driving head decrease when the inlet water velocity increases, and vice-versa. A design line of subcooling limit as a function of operating pressure is given; 3. Unstable flow loops can be stabilized by velocity head losses, such as at an orifice in the downcomer, and by the use of long downcomer pipes and consequent high single phase fluid inertia; and 4. Friction pressure drops and velocity head losses in the riser can help to stabilize, provided inlet subcooling is not excessive. If it is excessive, the riser friction pressure drop and head losses actually decrease when inlet water velocity increases. The result is a negative incremental pressure drop which destabilizes. (auth)

24945 (NAA-SR-Memo-6374) TORQUE TUBE SEAL-OIC FLOW CONTROLLER. D. J. Hovley (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 8, 1961. 6p.

A torque tube seal for a sodium flow controller is tested by being cycled 1000 times each at temperatures of 1000 and 1200°F in a flowing sodium system at a pressure of 100 psig. The tests are conducted in a test loop of the Hallam Power Reactor. No indication of leakage through the seal is noted under the test conditions. (T.F.H.)

24946 (NYO-9456) DESCRIPTION OF METHOD FOR DETERMINING GEOMETRIC PARAMETERS OF SURFACES IN CONTACT. Semi-Annual Progress Report, September 1960–April 1961. (Massachusetts Inst. of Tech., Cambridge). May 2, 1961. Contract AT(30-1)-2079. 16p.

A method and equipment are described for determining the surface parameters of contact required for heat transfer calculations. In this method, the output of a surface analyzer for one surface is recorded on one channel of magnetic tape and the output for the other surface of the contact pair on a second channel. The tape is played back to an analog computer which then integrates the analog voltage to compute the void volume thickness, the number of contact points, and the ratio of metallic contact area to the total area. (D.L.C.)

24947 (SCTM-146-61(13)) PRELIMINARY INVESTIGATION OF THE INTERACTION OF AN OBLIQUE SHOCK WAVE AND A TURBULENT BOUNDARY LAYER. J. K. Cole, V. J. Skoglund, and A. A. Trujillo (New Mexico. Univ., Albuquerque). May 1961. 110p. For Sandia Corp.

A continuous, two-dimensional, M = 2.5, wind tunnel with a one-inch square test section was modified to include a boundary layer probe and a shock-wave generating wedge. The point of incidence of the 29-degree shock wave was moved horizontally relative to the wall taps and the probe in the upper tunnel wall by moving the wedge vertically. Probe surveys were made upstream, in the middle, and downstream of the interaction of the shock wave and the turbulent boundary layer. The wall static pressures were measured with each probe survey. An investigation was made of the theory to determine the limitations of the approximate boundary layer equations. A theory for partially describing the interaction of turbulent boundary layers without flow separation was studied. The boundary layer upstream of the interaction had a boundary layer, displacement, and momentum thickness of 0.085, 0.0235, and 0.00619 inches, respectively. Its Reynolds number based on the effective length of the turbulent boundary layer was 7.2×10^5. The ratio of the downstream to upstream boundary layer thickness was 0.83. (auth)

24948 (TID-13078) PRESSURE GRADIENTS AND HEAT TRANSFER IN FORCED CONVECTION BOILING OF SUBCOOLED WATER. Forced Convection Vaporization Project. W. L. Owens and V. E. Schrock (California. Univ., Berkeley. Inst. of Engineering Research). June 30, 1959. For Univ. of California. Lawrence Radiation Lab. 74p.

Pressure and longitudinal tube wall temperature distributions were measured for forced convection boiling of subcooled water in two vertically mounted type 347 stainless steel test sections. Test sections inside diameters were 0.1181 and 0.1824 in. with heated lengths of 15 and 16 in., respectively. Distilled and degassed water was pumped upward through the test sections at mass fluxes of 170 to 1090 lb/sec ft^2 and pressures of 50 to 400 psia. The test sections were electrically heated by an alternating current providing surface heat fluxes of 2.2×10^5 to 1.27×10^6 Btu/hr ft^2. Wall thickness of the test sections was sufficient to effectively damp power fluctuations produced by a-c heating. Local pressure gradient data for the two test sections were correlated by the dimensionless equation:

$$\Psi^2 = 0.977 + 0.0282 \exp 6.125 \frac{l}{L},$$

where Ψ^2 is the ratio of two-phase pressure gradient to liquid pressure gradient and (l/L) is the fractional subcooled boiling length. No dependence on pressure or tube diameter was found for the experimental range of the variables. Heat transfer data for the nonboiling case occurring in a portion of the test section were correlated in the form of the Dittus-Boelter, Sieder-Tate, and Colburn equations with coefficients of 0.0207, 0.0195, and 0.0190, respectively. All data are within 10% of the correlation in each case and are in substantial agreement with previously reported data for a 0.1162-in. I. D. test section. Heat transfer data in the subcooled boiling regime are in substantial agreement with the Jens and Lottes equation. (auth)

24949 (TID-13089) BASIC EXPERIMENTAL STUDIES ON BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Monthly Progress Report for Month of November 1960. B. Matzner (Columbia Univ., New York. Engineering Research Labs.). Nov. 30, 1960. Contract AT(30-3)-177. 4p. (MPR-X-11-60)

Several unsuccessful attempts were made to obtain experimental data with the first 7-rod test section. Subsequent to this the test section was removed from the loop and examined to determine the causes of operating difficulties. The examination revealed the importance of separate investigation of problem areas in the design of this and future multi-rod test sections. With the successful completion of this program; multi-rod test sections would be constructed of individually proven components and would have a maximum certainty of satisfactory operation. Because of the necessity of further evaluation of the test program, the revised project schedule is not included. The fabrication of a new single rod test section was completed. The machining of a new shroud tube with ceramic segments for 7-rod test sections is progressing well. (auth)

24950 (NP-tr-650(Pts.I and II)) ANALOGY METHODS IN AEROHYDRODYNAMICS. (Methody Analogiy v Aerogidrodinamike). N. N. Suntsov. Translated from a publication of the State Publishing House of Literature on Physics and Mathematics, Moscow, 1958. (Pt.I, 243p. and Pt.II, 157p.).

A description is given of analog methods applicable to the solution of problems in aerohydrodynamics. The individual chapters include discussions on: general information on the methods and a history of their development and applications; the basic equations of aerohydrodynamics; and the exposition of the methods of electrohydrodynamic, magnetohydrodynamic, and gas-hydraulic analogies. The theoretical bases of the various methods are introduced in a form suited to the understanding of university students. The book may be considered useful also to engineers and others encountering problems in aerohydrodynamics. (B.O.G.)

24951 (NP-tr-667) DISTRIBUTION OF TEMPERATURES IN A CYLINDER WITH INTERNAL HEAT SOURCES AND COOLING BY A TURBULENT LIQUID FLOW. T. L. Perelman. Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 3: No. 11, 72-6(Nov. 1960). 4p.

Considerations are given for heat transfer by convection between a finite cylinder with arbitrary internal heat generation and its cooling by a turbulent liquid flow. The problem is reduced to the solution of a system of two linear integral equations for Laplace temperature models. (auth)

24952 TWO-PHASE SINGLE-COMPONENT PRESSURE DROP. Miodrag Novaković. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 67-85(Mar. 1961). (In English)

The pressure drop for flow in a uniform horizontal pipe of a two-phase single-component fluid medium was measured. The measurements related in all cases to a uniform heat supply along the test length. When expressed in terms of the pressure gradient the results are represented by $(dp/dL) = (dp/dL)_{AL}(1 + F.x + H.D.\ dx/dL)$, where- $(dp/dL)_{AL}$ is the all-liquid pressure gradient (before boiling) and dx/dL the dryness gradient. F and G are dimensionless parameters correlated to physical properties of the phases by $F = 2.21\ (v_V/v_L - 1)\ (\mu_V/\mu_L)^{0,2}$, $G = 5.27\ (v_V/v_L - 1)^{0,732} = H \cdot D/L$. The quantity actually observed was the pressure drop in a finite length of 51 diameters and is represented by the integrated form of the above equation for the gradient. Since the prediction covers the adiabatic case, it should be valid also for a two-phase medium of two immiscible fluid components. The result is valid for $0 < x < 0.3$, $0 < D\ (dx/dL) < 0.004$, and $1 < Re_L \times 10^{-3} < 3$. The only fluid used was water and the range of experiments covered $24 < v_V/v_L < 126$; $3.6 < \mu_L/\mu_V < 8$, corresponding to the working pressure range 14 to 75 at. The results are strictly valid for water-steam mixtures, as it was the working fluid. Since, however, they are in a dimensionless form they are expected to give a reasonable indication of the pressure drop for other substances. The formula used for $(dp/dL)_{AL}$ was $(dp/dL)_{AL} = (32m^2v_L/\pi^2D^5).(0.044).(Re_L)^{-0.2}$, wherein the last two terms, $0.044(Re_L)^{-0.2}$ represent the usual skin friction drag coefficient based on the stagnation pressure. (auth)

24953 SODIUM AND SODIUM-POTASSIUM ALLOYS AS HEAT TRANSFER MEDIA FOR STEAM REHEAT AND TECHNOLOGICAL PROCESSES. P. L. Kirillov. Teploenergetika, No. 10, 40-2(1960).

Sodium and alloys of sodium and potassium may be considered as heat transfer media. Their physical properties are given. Published data covers the range of 0-700°C and the data for higher temperatures are obtained by extrapolation. Reaction between sodium and water would have to be prevented, but that between sodium and steam is not so dangerous. Oxidation of the sodium must also be prevented for two reasons: the oxides are corrosive and they may form solid deposits in the tube. Before filling the system it would have to be heated to a temperature higher than the melting point of sodium which is 97°. This would not be required if the eutectic alloys of sodium and potassium were used, the melting point being below 20°C. A possible reheat circuit using sodium metal or sodium potassium alloy is illustrated schematically and the main characteristics are given. Various items of secondary equipment are described, including, for example, measurement of sodium oxide. If sodium or alloy leaked into the furnace it would quickly burn, forming oxides and carbonates most of which would be removed with the flue gases. The sodium does not come into contact with water. The pressure of the steam is much higher than that of the sodium and if any leak occurred it would be of steam into the sodium. Various kinds of protective measures that would be required are mentioned. The use of electromagnetic pumps for metallic sodium is recommended. A number of the advantages claimed are mentioned. Ordinary ferrite steels can be used in contact with sodium up to 450-500°C and austenitic steel up to 800°C, provided that the oxygen content does not exceed 0.005% by weight. (OTS)

24954 FLUID FLOW IN PIPES. Clifford H. McClain. New York, Industrial Press, 1952. 123p.

A summary of modern theory on the flow of liquids and gases through piping and ducts is presented with practical applications and detailed worked-out examples. Fluids are discussed in terms of properties such as viscosity and the effect of different kinds of pipes on its flow. Design practices are given for fittings, orifices, and other components of piping systems. (N.W.R.)

Instrumentation

24955 (AD-240184) THE DEVELOPMENT OF A RADIATION ALARM. Semi-Annual Progress Report Covering January 1 to June 30, 1960. (Norway. Forsvarets Forskningsinstitutt, Lillestrom). 12p.

The development of two radiation alarms (electrostatic and electronic) is reported. Work on the electrostatic alarm was concentrated on the electrometer and design of a relay. Some modifications were made in the circuitry of the electronic alarm. (D.L.C.)

24956 (ANL-6346(p.38-46)) EXAMPLES OF THE MERITS AND USAGE OF SOLID STATE DEVICES. John Gilroy (Argonne National Lab., Ill.).

A critical discussion of the relative merits of solid-state devices is presented using thermocouples, semiconductors, and crystals as examples. It is empahasized that the choice should be made only after a detailed, critical analysis of each proposed device. The a-c differential transformer bridge is treated in detail to illustrate the use of such analysis. (D.L.C.)

24957 (BNL-5617) 3 KILOJOULE-4 KILOVOLT FLASH TUBE CAPACITOR CHARGING SUPPLY. D. Miller and J. P. Palmer (Brookhaven National Lab., Upton, N. Y.). Sept. 1, 1960. 10p. (IHR-101)

The charging supply of capacitors for use in conjunction with a flash tube to provide high-resolution, high-intensity controllable light sources is described. Such light sources are required in photographic systems to record particle tracks in bubble chambers. The charging supply has sufficient capacity to deliver up to 6 kw at 5 kv to the flash tube load. The description is provided primarily for those who will use the device. (J.R.D.)

24958 (BNL-5619) INTEGRATOR AND DIGITIZER—IH-78-1. R. L. Chase (Brookhaven National Lab., Upton, N. Y.). May 8, 1961. 5p. (IHR-103)

Design and operation of this apparatus is described. The circuit integrates the anode current of a photomultiplier tube during the time interval between the start and stop pulses from a pair of predetermined counters. Specifications are given, and information on zero adjust, dark current adjust, and intercalibration is given. (J.R.D.)

24959 (DPST-57-111) CALIBRATION OF MINIATURE FISSION CHAMBERS FOR MEASURING FAST AND SLOW NEUTRON FLUX. J. L. Hyde (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Jan. 11, 1957. 23p.

Small fission chambers using U^{238}, Th^{232}, and Np^{237} as threshold detectors for fast neutrons were prepared and standardized for absolute measurements of fast-neutron flux in a fission-neutron spectrum. The standardization could also be applied to other distributions of fast neutrons if the spectra were known with sufficient accuracy. Similar detectors using U^{235} as the fissionable isotope were made and standardized for use in the thermal energy range. Calibrations of the chambers are given. Where the coating thickness of the detecting nuclide was known, it was shown that the sensitivity of the chamber was equal to about 90% of the theoretical sensitivity of the detecting nuclide. It is believed that through use of the calibrations, absolute accuracy better than 10% (plus the error in the standard neutron source) is obtainable for flux measurements in known spectra. A reliable method was developed for making waterproof electrical connections, and a low-noise preamplifier permitted use of cables 30 ft or more in length, having up to 500-$\mu\mu$F capacitance. (auth)

24960 (FZM-2013) A PROPOSAL FOR IMPROVING THE ACCURACY OF NEUTRON-SPECTRUM MEASUREMENTS WITH FOILS. W. E. Dungan (Convair, Fort Worth, Tex.). June 15, 1961. 22p.

Procedures used in neutron-flux-spectrum measurements by foil techniques are outlined and some limitations are noted. A procedure is proposed whereby an alternate method may be used for obviating some of the limitations, extending the range, simplifying the analyses of foil data, and increasing the accuracy of neutron-spectrum measurements. (auth)

24961 (HW-SA-2203) SPECIFICATIONS, THERMOCOUPLES METAL SHEATHED, CORROSION RESISTANT, FOR NUCLEAR SERVICE. Bert S. Kosut (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [June 1961?]. Contract AT(45-1)-1350. 17p.

Requirements are presented for corrosion-resistant, metal-sheathed, two-wire thermocouples for nuclear service at elevated temperatures in contact with fissionable materials, water, liquid metals, or gaseous atmospheres. (auth)

24962 (JEN-85-DQ/I-22) EL CUANTOMETRO COMO INSTRUMENTO ANALITICO EN EL CONTROL DE MATERIALES NUCLEARES. (The Quantometer as an Analytical Instrument in the Control of Nuclear Materials). F. Alvarez Gonzalez, M. Roca Adell, R. Fernandez Cellini (Spain. Junta de Energia Nuclear, Madrid). 1961. 21p.

To solve problems of chemical analysis in nuclear industry and research, a Quantometer is used with a high number of channels. A study to choose the more suitable spectral lines is described. The different channels are distributed into two programs to allow the analysis of high and low concentrations. The Quantometer is being applied successfully to analyze soils, plant ashes, rocks and ores, uranium and its compounds, zirconium, graphite, alloys, and other nuclear materials. (auth)

24963 (JPLAI-LS-205) MEASUREMENT OF GAMMA RADIATION. Astronautics Information Literature Search No. 205. Dorothy Sweitzer, comp. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Mar. 1, 1961. Contract NASw-6. 37p.

An annotated bibliography is presented consisting of 166 references to measurements of gamma radiation found in reports and the open literature through March, 1961. An author index is included. (B.O.G.)

24964 (NAA-SR-1137(Pt.II)) ABSOLUTE THERMAL NEUTRON DETERMINATION. PART II. ABSOLUTE BETA COUNTING OF INDIUM FOILS. Roscoe L. Koontz, Moses A. Greenfield, and Alan A. Jarrett (North American Aviation, Inc., Downey, Calif.). Oct. 1, 1955. 35p.

Correction factors for the effect of thickness on the self-scattering, self-absorption, and backscattering of beta particles from indium foils were determined for irradiated foils of 0.03 to 100 mg/cm^2. The data were corrected for the activity produced by epithermal neutrons, self-shielding of thermal neutrons by the foil during irradiation, the backscatter from the foil support, and the contributions of gamma and x rays to the counting rate. The multiple beta spectra of indium produced a minimum in the self-absorption and self-scattering correction curve in the GM detector at ~1 mg/cm^2 and a maximum at ~12 mg/cm^2. The self-absorption curve for indium in the 2π counter has the expected shape for a beta emitter with multiple spectra. The self-scattering and self-absorption correction factors for a 100 mg/cm^2 indium foil are ~1.5 for a GM detector at 7% geometry and ~3 for a 2π counter. (D.L.C.)

24965 (NAA-SR-Memo-6284) RELIABLE MICROSECOND COINCIDENCE CIRCUIT FOR FAST-SLOW SYSTEMS. L. S. Beller (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 13, 1961. 21p.

A stable and reliable coincidence circuit with resolving times of ~0.1 to 10.0 μsec is presented. The instrument is intended to be used in a fast-slow system, with inputs supplied by pulse-height analyzers consisting of DD-2 amplifiers and fast coincidence circuits. Details of circuit design, construction, adjustment, and testing are given. (auth)

24966 (NP-9547) DEVELOPMENT AND FABRICATION OF NON-DESTRUCTIVE SPECIFIC GRAVITY MEASURING EQUIPMENT EMPLOYING RADIATION TECHNIQUE. Monthly Progress Report for November, 1960. (Kaman Aircraft Corp. Kaman Nuclear Div., Colorado Springs). Contract DA-19-059-501-ORD-2631. 11p. (58-92-PR-27)

Detailed drawings for the densitometer probe carriage assemblies were completed and checking was begun. Design on the mounting frame for sample carriage and probe carriage assemblies was started. Design changes were made in the nuclear safety system to eliminate interferences with the probe carriages. The support table and the attenuator assembly were received and checked. Bids were received on the source support platforms. The completed assembly drawings are included. (auth)

24967 (NP-10444) NEUTRON SURVEY METER RADIAC SET. AN/PDR-58 (XN-1). Final Development Report, April 1959 Through January 1961. (American Machine and Foundry Co., Alexandria, Va.). Apr. 1961. Contract Nobsr 77552. 178p.

An extensive experimental program was conducted to develop a scintillation-type neutron survey meter which would measure neutron radiation directly in units of mrem/hr. The evolved detector was a multiple-sandwich

lucite matrix which contained Li^6F and ZnS(Ag). By surrounding this detector with a shield made of B^{10}, Ti, and Mn, the output of the detector as a function of neutron energy very closely approximated the mrem/hr per unit neutron flux specified by the National Bureau of Standards Handbook 63. This completely portable battery-powered instrument was given the U. S. Navy nomenclature Radiac Set AN/PDR-58 (XN-1). (auth)

24968 (NYO-2657) THE DEVELOPMENT OF A BETA-RAY PARTICLE SIZE ANALYZER. Final Report, April 15, 1959—April 15, 1961. Seymour Z. Lewin, Jane Connor Sheridan, and Eric J. Hewitt (Evans Research and Development Corp., New York). Contract AT(30-1)-2372. 103p.

An approach to the determination of particle sizes and particle-size distributions was developed. The method is based upon measurements of the relative spread in replicate determinations of scattered radiation intensity as a function of viewing aperture diameter. It was shown that radiations ranging in nature from light to beta particles may be utilized. The theory of the new method has been verified by means of measurements of the intensity of the backscattering of C^{14} betas from monosized lead spheres under the conditions required by the theory. (auth)

24969 (ORNL-3129) INLINE DENSIMETER FOR PULSED COLUMN LIQUID DENSITY, PULSE AMPLITUDE, AND PULSE FREQUENCY MEASUREMENTS. T. S. Mackey (Oak Ridge National Lab., Tenn.). July 19, 1961. Contract W-7405-eng-26. 13p.

An inline densimeter was fabricated and tested in the laboratory. When operated in a range of 1.000 to 1.200 g/cc, an accuracy of ±0.2% in the mid-point of the range was easily achieved. The instrument also measures pulse amplitude and pulse frequency when used on a pulsating flow. A long life with high reliability is expected because of the simple all-welded construction and highly reliable electronic system. (auth)

24970 (SCTM-98-61-(14)) PRACTICAL ANALYSIS OF BLOCKING OSCILLATORS. Richard D. Griffith (Sandia Corp., Albuquerque, N. Mex.). Apr. 1961. 97p.

The analysis and design of blocking oscillators, in terms of measurable parameters, are considered. A nonlinear analysis of vacuum tube circuits and a piecewise linear analysis of transistor circuits are presented for the quasi-stable region. It is shown that circuits of great practical value can be designed using the inherent pulse-terminating characteristics of the tube and transistor. Comparisons between theoretical and experimental results are included. (auth)

24971 (UCRL-6292-T) THE LIVERMORE 90-INCH-CYCLOTRON NEUTRON-TIME-OF-FLIGHT FACILITY. John D. Anderson and Calvin Wong (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 3, 1961. Contract W-7405-eng-48. 17p.

The 90-inch cyclotron is a variable-frequency cyclotron operating at from 4 to 10 Mc. The standard neutron time-of-flight electronics are composed of a biased plastic scintillator for a detector, a time-reference signal derived from the cyclotron r-f, a time-to-pulse-height converter, a slow amplifier and discriminator, and an Argonne-type 256-channel pulse-height analyzer. Several additions to the basic system were found necessary. A description of the modifications is presented. (auth)

24972 (UCRL-6441) OBSERVATIONS ON THE RESPONSE OF A LITHIUM-DRIFTED DETECTOR TO PROTONS. Jacob Benveniste, Rex Booth, and Arthur C. Mitchell (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 18, 1961. Contract W-7405-eng-48. 9p.

The response of a lithium-drifted solid state detector was measured for protons and found to be linear up to the highest energy observed, 13.2 Mev. The resolution observed for these protons is 0.81% with a bias of 500 volts and 0.65% with a bias of 250 volts. (auth)

24973 (UCRL-9504) A THEORETICAL COMPARISON OF 4π FAST-NEUTRON SPECTROMETERS (thesis). Chul Mo Kim (California. Univ., Berkeley. Lawrence Radiation Lab.). Nov. 1960. Contract W-7405-eng-48. 69p.

The relative merits of various 4π fast-neutron spectrometers are compared on a theoretical basis. Such features as efficiency, energy resolution, useful energy range, directionality, time response, and gamma-ray and background sensitivity are considered, in order to select the most promising types of 4π fast-neutron spectrometer for further development. (auth)

24974 (UCRL-9651) PORTABLE ALPHA-SURVEY INSTRUMENT. William J. Roach and Robert J. Walker (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 17, 1961. Contract W-7405-eng-48. 9p.

A transistorized, portable alpha-survey instrument was developed. Features included are: time-proved air proportional probe (18 $in.^2$ area); D-cell powered, built-in speaker and audio amplifier; circuit board modules; and sufficient sensitivity and high-voltage power to operate almost any similar type of detector without modification. (auth)

24975 (WADD-TR-60-576) PHOTOCONDUCTIVITY IN CdS CRYSTALS AS A MECHANISM FOR GAMMA RAY DOSIMETRY. O. Van P. Sessoms, III (Wright Air Development Div. Materials Central, Wright-Patterson AFB, Ohio). Nov. 1960. 27p.

Gamma ray-induced changes in the conductivity of CdS crystals are studied as a possible mechanism for monitoring gamma dose rates. Data are presented on the change in conductivity due to gamma exposure over a range of 1.4×10^5 to 5×10^7 ergs/g/hr (C). The change in photocurrent as a function of voltage at two dose rates is also reported. The rise time of this photocurrent is investigated for photons in the visible light range as well as for Co^{60} gamma rays. (auth)

24976 (Y-1356) AUTOMATION OF LECO CARBON ANALYZERS. J. J. Henry (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). June 5, 1961. Contract W-7405-eng-26. 14p.

The measuring processes of two Leco carbon analyzers, used for the determination of the carbon content of solid samples, were automated by providing a servo measuring system, electrical time sequence controls, and nixie digital indicators. The automation relieves the analyst from continuous attendance at the instrument during the measurement process and provides for more efficient employment of the analyst's time. (auth)

24977 (JPRS-9672) USE OF "TISS" RADIOMETER FOR RECORDING OF SOFT BETA RADIATION. A. O. Furman and E. Ye. I. Kobazev. Translated from Izvest. Timiryazev. Sel'skokhoz. Akad., No. 2, 232-3(1961). 7p.

A description is given of the construction, characteristics, and uses of a TCh-M transducer used in conjunction with the TISS radiometer for measuring contamination of surfaces caused by such isotopes as: C^{14}, S^{35}, Ca^{45}, and others used extensively in research. (B.O.G.)

24978 ADAPTER FOR ALPHA COUNTING WITH CONVENTIONAL LOW LEVEL BETA COUNTER. M. L. Gon-

shor, J. E. Green, and R. E. Wood (Kennecott Copper Corp., Salt Lake City). Anal. Chem., 33: 1293-4(Aug. 1961).

An improvement in technique for alpha radioactivity measurements is described. (P.C.H.)

24979 A METHOD OF IDENTIFYING CHARGED PARTICLES. B. Forkman and S. A. E. Johansson. Arkiv. Fysik, 19: 99-107(1961). (In English)

A method for identifying charged particles is described. It consists of a combination of a magnetic field and nuclear emulsions. The orientation and length of the tracks in the emulsions are measured and the trajectories of the particles in the magnetic field are calculated, assuming them to be protons, deuterons, or α particles. The intersection point relative to the position of the target in the various cases makes it possible to identify the particles. The method was used successfully in an investigation of the charged particles emitted in photonuclear reactions. (auth)

24980 INVESTIGATION OF THE EFFICIENCY OF VAPOR CONDENSATION OF IONS IN A WILSON CLOUD CHAMBER. Lj. Dobrilović and A. Milojević. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 15-22(Mar. 1961). (In English)

Certain factors influencing the efficiency of vapor condensation on ions were investigated. For this purpose an analysis of beta particle tracks in the interval 0.2 to 1.4 Mev was made for air– C_2H_5OH and air– $C_2H_5OH + H_2O$ mixtures. The mean value of the number of drops formed on negative and positive ions was found to be 0.72 ± 0.05 for system (I), and 0.79 ± 0.06 for system (II). The mean value of the condensation efficiency on positive ions was 0.69 ± 0.05 for system (I), and 0.89 ± 0.07 for system (II). As to the air– C_2H_5OH system, the condensation of drops in function of the expansion ratio was analyzed and the critical value for condensation on negative ions at the expansion ratio of 1.205 under normal experimental conditions was found. (auth)

24981 TEMPERATURE DISTRIBUTION IN A DIFFUSION CLOUD CHAMBER. I. Slavić, J. Szymakowski, D. Stachorska, A. Milojević, and A. Ajdačić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 23-35(Mar. 1961). (In English)

A diffusion cloud chamber with working conditions within a pressure range from 10 mm Hg to 2 atmospheres and at variable boundary surface temperatures in a wide interval is described. A simple procedure is described for cooling and thermoregulating the bottom of the chamber by means of vapor flow of liquid air which makes possible the achievement of temperature up to −120°C with stability better than ±1°C. A method for the measurement of temperature distribution by means of a thermistor is described, and a number of curves of the observed temperature gradient, dependent on the boundary surface temperature is given. Analysis of other factors influencing the stable work of the diffusion cloud chamber was made. (auth)

24982 DOUBLE-CRYSTAL NEUTRON SPECTROMETER. Miodrag D. Živanović, Dorde M. Jović, and Jovan M. Konstantinović. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 59-65(Mar. 1961). (In English)

The double-crystal neutron spectrometer described was built for reactor research (6.5 to 10 Mw) at the Institute of Nuclear Sciences. The spectrometer is a fully automatic, universal machine and can be used as a single-crystal, double-crystal, or three-crystal neutron spectrometer. (auth)

24983 DIFFERENTIAL HIGH PRESSURE GAUGE. Miodrag Novaković. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 88-91(Mar. 1961). (In English)

A differential pressure gage of high sensitivity is described. The instrument is a well-type mercury manometer consisting of one part with a visible mercury column connected to a movable well by a flexible hose. The visible mercury column is obtained by a combination of steel and perspex plates in such a way as to provide three additional visible columns (for other measurements). The differential pressure is measured by reading the height of the mercury in the visible column and by reading the position of the well (which changes discretely). (auth)

24984 COUNTING CHARACTERISTICS OF NATIVE METHANE INVESTIGATED BY A 4π PROPORTIONAL FLOW COUNTER. Djordje N. Bek-Uzarov and T. K. Rzeszot. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 277-80(Mar. 1961). (In English)

Counting characteristics of native methane (Lendava Slovenia) were investigated. No purification of gas was found to be necessary when measurements are performed with statistics up to 2%. The construction of a 4π flow proportional counter is described. The pressure in the flow counter did not exceed 4 cm Hg. (auth)

24985 A RADIOFREQUENCY MASS-SPECTROMETER. E. F. Doyl'nitsyn. Byull. Izobret., No. 13, 61(1960).

The spectrometer incorporates a casing, an ion source, electric motors, and a vacuum tap. It uses a greater number of ions at a time and measures the relation of two arbitrary masses of gas. The analyzer is made of two arms and is operated by one ion source. (OTS)

24986 A FLOWMETER WITH MAGNETIC NUCLEAR RESONANCE PICKUP. A. I. Zhernovoy. Byull. Izobretnii, No. 17, 50(1960).

This pickup includes a permanent magnet, a pipe and a nuclear resonance pickup coil. To increase the accuracy and widen the range of measurements, the pipe is made in the form of a toroid and the nuclear resonance pickup coil is wound along the whole surface of the toroid. (OTS)

24987 INCREASING THE EFFICIENCY OF SCINTILLATION DETECTORS FOR SLOW NEUTRONS. B. S. Grebenskii, T. V. Timofeeva, S. P. Khormushko, and O. S. Tsvetkov. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 500-3(Apr. 1961). (In Russian)

A slow-neutron detector containing boron both in its natural isotopic mixture and also enriched in B^{10}, was obtained by calcining ZnS-Ag and H_3BO_3 together. The resulting mixture was ground, using a chosen particle size fraction for the preparation of the detector. The transparency of the material for the radiation-induced scintillation is dependent on the absorption and scattering constants at the particle-air boundary and the ZnS-Ag interface and may be quantitatively determined by the $ZnS\text{-}Ag/B_2O_3$ ratio, over-all particle size, and the phosphor grain size. An increase of the particle size while keeping the composition and the thickness of the layer constant results in a reduction of the light scattering and thus in an increase of the transparency which in turn makes it possible to increase the thickness of the layer. However, the scintillation is weakened by self-absorption of the particles and the attenuation of the neutron flux in the internal layer. The dependence of the pulse amplitude on the gamma-rays of Cs^{137} and Ra and on slow neutrons was experimentally determined. It was found that the sensitivity toward gamma-rays is by 3 orders of magnitude larger than toward slow neutrons. (TTT)

24988 DISPERSION-TYPE DETECTOR FOR FAST NEUTRONS. G. V. Gorshkov, B. S. Grebenskii, S. P. Khormushko, and O. S. Tsvetkov. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 504-5(Apr. 1961). (In Russian)

A fast neutron detector was developed on the basis of ZnS-Ag grains uniformly distributed in a hydrogenous medium. The recoil protons, formed by impact cause the flashes of light. The previously known types of detectors were improved by using polymerized styrene and methyl methacrylate. The grain diameters were kept between 12 and 25 μ, the afterglow τ was found to be about 10^{-4} sec and the maximum of intensity of the natural radiation was between 4100 and 4500 A which agrees well with the maximum spectral sensitivity of an instrument with Sb-Cs photocathode. The effects of the various parameters, such as the index of refraction of the detector grain and the hydrogenous material, the grain size, and the ZnS-Ag concentration were studied, determining the efficiency of the detector by means of a Po_{α} + Be and $RaTh_{\gamma}$ + Be sources. The relative change of the efficiency of recording light flashes as a function of the weight concentration of the phosphor was found to be represented by an exponential function, similar in shape to the absorption curve. The detector was found to be responsive to neutrons with an energy of 0.5 Mev. (TTT)

24989 AN APPARATUS FOR MEASURING THE LUMINESCENCE PARAMETERS OF FLUORESCENT SCREENS. B. I. Pochtarev, K. K. Raspletin, and D. V. Fetisov. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 512-14(Apr. 1961). (In Russian)

An electrostatic optical system was used for studying the basic characteristics of cathodic phosphors and screens, including the resolving power, the spectral composition of luminescence and the effect of the degree of purity of the surface. The experimental chamber, evacuated to 1 to $3 \cdot 10^{-4}$ mm of Hg contained the screens or powder phosphors; the light emission of the yellow-green and blue screens was measured by Se and Sb-Cs photoelements, respectively. In view of the low intensity of the radiation emitted by the phosphors, a photomultiplier was used in some cases. (TTT)

24990 THE APPLICATION OF BEAM COOLING TO QUADRUPOLE AMPLIFIERS. C. P. Lea-Wilson, T. J. Bridges, and J. C. Vokes (Services Electronics Research Lab. Extension, Admiralty, Harlow, Essex, Eng.). J. Electronics and Control, (1) 10: 261-72(Apr. 1961). (In English)

The noise figure of the d-c pumped quadrupole amplifier can be considerably improved by the use of beam-cooling techniques. A practical design of tube incorporating these techniques is described for use at 400 Mc/s. This has a theoretical beam temperature of 16°K which should result in a noise figure of less than 1 db. It is shown that these techniques get progressively more difficult at higher frequencies. The useful limit probably lies between 3000 and 10000 Mc/s. (auth)

24991 THE TRANSVERSE ELECTRIC NOISE FROM AN ELECTRON BEAM. F. N. H. Robinson and R. N. Franklin (Clarendon Lab., Oxford). J. Electronics and Control, (1) 10: 277-84(Apr. 1961). (In English)

The transverse electric noise is due to velocity components perpendicular to the direction of an electron beam. A means of detecting the transverse noise is investigated theoretically and the problem of discriminating it from shot noise is considered in detail. An experiment is described in which the measurement of the transverse noise is used to demonstrate the scattering of an electron beam. (auth)

24992 PHASE AND MODULATION FLUOROMETER. J. B. Birks and D. J. Dyson (Univ. of Manchester, Eng.). J. Sci. Instr., 38: 282-5(July 1961).

The instrument, which is designed for the measurement of fluorescence decay times of 10^{-7} to 10^{-9} s, comprises a 10 Mc/s hydrogen discharge lamp, fast photomultiplier, variable delay line, and detector circuit for phase and modulation analysis of light signals from the lamp and specimen. Studies are made of the transit time variations in 56 AVP and 6810 A photomultipliers, and preliminary measurements are made of the fluorescence decay time of quinine sulfate solutions. (auth)

24993 FIXED ATTENUATORS CONSISTING OF A NETWORK OF IDENTICAL RESISTORS. C. H. Vincent (United Kingdom Atomic Energy Authority, Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Sci. Instr., 38: 288-90(July 1961).

Fixed attenuators constructed of identical resistors have advantages of freedom from distortion by the stray self-inductance of the resistors and freedom from the effects of ambient temperature changes. A suitable form for such attenuating networks is described. It is possible to design a network of this form to give attenuation in any ratio N to 1, where N is an integer. The minimum number of resistors needed for any value of N is not excessive, being less than seven resistors per decade of N. A table is given which makes the calculation of an optimum network very easy for any value of N up to 400. (auth)

24994 RADIOTHERMOLUMINESCENT DOSIMETER. [PART] I. Zdeněk Spurný (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Prague). Jaderná energie, 7: 205-6(1961). (In Czech)

The design is given of a radiothermoluminescence dosimeter, 3 mm in diameter and 20 mm long, capable of measuring γ rays from 1 to 10000 r. (R.N.J.)

24995 PHOTOFRACTIONS FOR SODIUM IODIDE CRYSTALS. W. E. Kreger and R. M. Brown (Naval Radiological Defense Lab., San Francisco). Nuclear Instr. & Methods, 11: 290-6(May 1961). (In English)

Measurements of the pulse-height spectra obtained from large crystal NaI(Tl) scintillation spectrometers exposed to monoenergetic gamma rays are used to determine the photofractions (ratio of total-absorption peak area to total spectrum area) for the crystals. The NaI crystals used have geometries such as 4 inch diameter by 4 inch long; 5 inch diameter by 6 inch long with a $\frac{3}{4}$ inch diameter by $1\frac{1}{2}$ inch deep well drilled in the end; and $9\frac{3}{8}$ inch diameter by $8\frac{5}{8}$ inch long with a $\frac{3}{4}$ inch diameter by $2\frac{1}{2}$ inch deep well drilled in the end. The units are exposed to collimated monoenergetic gamma rays from 0.279 Mev to 2.76 Mev. The dependence of photofraction value on gamma-ray beam diameter is determined for the 4 inch by 4 inch crystal. The photofraction values are fitted to an empirical relationship involving crystal radius and length, with three gamma-ray energy dependent parameters as fitting variables. (auth)

24996 APPLICATION OF SURFACE BARRIER SOLID STATE IONIZATION CHAMBERS TO MEASUREMENTS ON FISSION. Edward Melkonian (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Instr. & Methods, 11: 307-15(May 1961). (In English)

Gold-silicon surface barrier detectors $\sim\frac{3}{4}''$ in diameter are used in several experiments on the fission process. A pair of detectors, with detecting surfaces parallel and facing each other at a distance comparable with their diameters and with U^{235} deposited on one detector, is used to measure the mass distribution in thermal neutron fission for several values of the total kinetic energy of the fragments. Values as high as 500 to one for the ratio of asym-

metric to symmetric fission are obtained. A similar arrangement, but including a third detector, is used for the measurement of the mass distribution in ternary fission. The ratio of ternary to binary fission for U^{235} thermal neutron fission is determined. The variation of the fission cross section of U^{233} with energy is measured for neutron energies in the range 6 to 19 ev. The usefulness of solid state detectors and their superiority over other types of detectors for these measurements is noted. (auth)

24997 PILE UP REJECTION CIRCUITS. S. Rozen (Rozenstein) (Ministry of Defence, Tel-Aviv, Israel). Nuclear Instr. & Methods, 11: 316-20(May 1961). (In English)

The main background pile-up effects and the methods used for their rejection are described. Two circuits are described, which generate gates that interact with the signals to be registered every time a pile-up effect is detected. The first circuit has a resolving time of 350 nsec and a pile-up threshold level of 4 v, when operated from the output of an ordinary amplifier. The resolving time and threshold level of the second circuit are reduced to 30 nsec and 1 v respectively, when operated directly from the dynode output. The scintillator used is NaI(Tl). (auth)

24998 DETECTION SYSTEM OF PARTICLES ANALYZED BY A MAGNET. R. Chaminade, M. Cros, A. Papineau, and J. Saudinos (Centre d'Etudes Nucleaires, Saclay, France). Nuclear Instr. & Methods, 11: 321-5(May 1961). (In French)

A detection system is described that locates and counts particles analyzed by a magnet. Ten proportional counters and a scintillation counter allow the detection of particles on twenty independent bands of 5 mm width. A description is given of the associated electronics. (auth)

24999 MEASUREMENT OF SHORT PERIODS BY SEMICONDUCTOR AND PHOTOMULTIPLIER CIRCUITS. R. Ballini and E. Pomelas (Centre d'Etudes Nucleaires, Saclay, France). Nuclear Instr. & Methods, 11: 331-5(May 1961). (In French)

Pulses (saturated and of definite lengths), produced at low impedances by the current of the last electrodes of a photomultiplier, are applied to semi-conductor circuits. A time definition of a few nsec is obtained under experimental conditions. (auth)

25000 THE NON-PROPORTIONAL RESPONSE OF NaI(Tl) CRYSTALS TO γ-RAYS. P. Iredale (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Instr. & Methods, 11: 336-9(May 1961). (In English) (AERE-R-3340)

Measurements are made of the variations in light output, L, with energy, E, for γ-rays that are totally absorbed in NaI(Tl) crystals. In the energy range 0.046 to 1.33 Mev the scintillation efficiency, L/E, varies by 20%, being greatest at the lowest energy. By a careful choice of calibration sources and control of measurement conditions the results are made sufficiently precise to allow the evaluation of L/E to within 0.3% and dL/dE to within 2%. The results are used to show the variation of dL/dE with density of ionization along the path of an electron. (auth)

25001 THE EFFECT OF THE NON-PROPORTIONAL RESPONSE OF NaI(Tl) CRYSTALS TO ELECTRONS UPON THE RESOLUTION FOR γ-RAYS. P. Iredale (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Instr. & Methods, 11: 340-6(May 1961). (In English)

The resolution of NaI(Tl) scintillation spectrometers for γ-rays is discussed, with particular reference to the intrinsic crystal resolution. Experiments indicate that differences in efficiency of light collection from various parts of the crystal and variations in photocathode efficiency have only a small effect upon the resolution. It is shown that because of the non-proportional response of NaI(Tl) to electrons, there is a contribution to the resolution arising out of the variations in number and energy of electrons involved in the total absorption of a γ-ray. Approximate calculations indicate that the magnitude of this effect is such that it could be completely responsible for the intrinsic crystal resolution. (auth)

25002 A MAGNETIC SPECTROGRAPH FOR ANGULAR DISTRIBUTION MEASUREMENTS. V. M. Rout, W. M. Jones, K. Firth, D. P. R. Petrie, and A. C. L. Barnard (Associated Electrical Industries, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods, 11: 347-54(May 1961). (In English)

The design and performance of a high-resolution, broad range magnetic spectrograph are described. The angle of entry at the pole edge is chosen to give second order focusing, so the recorded line width is almost entirely due to the width of the object slit and target thickness. The instrument has an energy resolution of 1040, using a natural α-emitting source, and is thus suitable for studying the properties of closely-spaced nuclear energy levels. An energy range of three to one is recorded on a single plate for a given field and six exposures may be carried out in succession without breaking the vacuum. (auth)

25003 A DIFFERENTIAL-COINCIDENCE CIRCUIT FOR THE NANOSECOND RANGE. W. Meiling, J. Schintlmeister, and F. Stary (Technische Hochschule, Dresden and Zentralinstitut für Kernphysik, Rossendorf, Ger.). Nuclear Instr. & Methods, 11: 355-61(May 1961). (In German)

The method of differential-coincidence is explained. A differential-coincidence circuit working according to the "crossed-delay-line" principle is described. The stability is good enough to obtain a minimum resolving time of 0.5% of the length of the input pulses. For example, using pulses of 0.3 v amplitude and 15 nsec duration from a mercury-pulse generator, a resolving time (half width of coincidence curve measured at half height) of 0.08 nsec is obtained. Branched pulses of 30 nsec duration produced by a photomultiplier and scintillator yield a resolving time of 0.27 nsec. (auth)

25004 SECONDARY ELECTRON MULTIPLIER FOR INVESTIGATION OF NUCLEAR EMULSIONS. Gerhard Luck (Zentralinstitut fur Automatisierung, Jena, Ger.). Nuclear Instr. & Methods, 11: 362-4(May 1961). (In German)

Automatic analysis of tracks in emulsion necessitates a light-sensitive detector with a good time resolution and a high photoelectrical transconductance. Multipliers have advantages over other detectors of this kind. (auth)

25005 GAMMA RAY SPECTRA IN LARGE ORGANIC SCINTILLATORS. P. R. J. Burch (Univ. of Leeds, Eng.). Proc. Phys. Soc. (London), 77: 1125-32(June 1, 1961).

For moderately large organic scintillators, a linear relation is found between the position of the γ-ray Compton peak and the maximum energy transfer in a first Compton collision. Extrapolation yields a positive intercept on the energy axis, as a result of the dependence of the specific light output of scintillators on the linear energy transfer of charged particles. The broadening of the Compton peak on the high-energy side has statistical components, intrinsic line broadening components arising from multiple interactions of the γ-ray, and geometrical components resulting from the variation of light collection efficiency with the

position of the event in the scintillator. The dependence of these three components on γ-ray energy is considered and their approximate magnitudes for two plastic scintillator units are calculated from experimental γ-ray spectra. (auth)

25006 NITROUS OXIDE AS A DOSIMETER FOR IONIZING RADIATIONS. J. A. Hearne and R. W. Hummel (Wantage Research Lab., Berks, Eng.). Radiation Research, 15: 254-67(Aug. 1961).

Absolute measurements of the radiolytic yields of O_2, N_2, and oxides of nitrogen ($NO + NO_2$) from gaseous nitrous oxide, with tritium as internal source, have been compared with the yields obtained by irradiation with Co^{60} γ rays and 4-Mev x rays based on the ferrous and ceric sulfate dosimeters. Of the three products measured, nitrogen gives the most reliable results, with $G(N_2) = 11.0 \pm 0.4$. The oxygen and oxides of nitrogen yields are affected by foreign gases and by the analytical methods employed. Under certain conditions a liquid dosimeter solution can be used in conjunction with electron density ratios to calculate energy absorption in a gas irradiated in the same vessel. (auth)

25007 ON THE AMPLIFICATION FACTOR OF PHOTOMULTIPLIERS. A. N. Pisarevskii and E. D. Teterin. Trudy Radievogo Inst. im V. G. Khlopina, 9: 152-4(1959).

The comparison of the amplification factors of photomultipliers of the 1B(1V) type (group of 8 pieces), which were measured under statical (σ_{st}) and pulse (σ_p) conditions, showed considerable differences in character (on the average for the group $\sigma_{st} : \sigma_p \approx 1.7$). Analogous experiments with amplifiers of the FEU-12 type (the dynodes of which are produced from Cu—Al—Mg alloy), show that the cause of differences in the 1V type (Al—Mg alloy) is their dynode material. (Referat. Zhur. Fiz., No. 6, 1960)

25008 MULTIDIMENSIONAL MEASUREMENTS OF SPECTRA IN NUCLEAR PHYSICS. G. P. Mel'nikov. Uspekhi Fiz. Nauk, 73: 767-73(Apr. 1961). (In Russian)

The general problem of measurements of nuclear spectra which are not functions of a single variable is discussed. Electronic apparatus for this purpose is described by means of block diagrams and a limited number of schematic circuit diagrams. A scheme is presented by which a 256-channel analyzer can be broken up into sixteen 16-channel analyzers. (TTT)

25009 ELECTROPHOTOGRAPHY OF PROTON BEAMS. B. M. Golovin, I. S. Zheludev, N. T. Kashukeev, V. M. Fridkin, and A. Antonov (Inst. of Crystallography, Academy of Sciences, USSR; Inst. of Physics, Academy of Sciences, Bulgaria; and Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Nauch. i Priklad. Fot. i Kinematografii, 5: 207-8(1960).

A study is reported of the sensitivity of various electrophotographic layers to fast protons. The experiments were carried out on a synchrocyclotron. The maximum intensity of the proton beam was about $10^8/cm^2/sec$ and the energy was 680 Mev. Various electrophotographic layers were investigated, including ZnO, ZnS, CdS, and polycrystalline sulfur, all deposited on paper. The layers were negatively charged by a corona discharge in air. The charged layers were then placed in a special holder fixed to the collimator with its plane perpendicular to the beam. Dry developers were used in the case of the sulfur layers. Four electrophotographic images of the proton beam obtained in the ZnO layer with the beam in various angular positions relative to the axis of the collimator are shown. The electrophotographs show a nonuniform background due to an edge effect associated with the electrostatic nature of the latent image. These edge effects can be reduced with the aid of a suitable screen. Photographs obtained with and without a screen are also shown. It was found that electrophotographic layers of ZnO and polycrystalline sulfur are the most sensitive to protons. With maximum beam intensity the minimum exposure time at 680 Mev was found to be 5 to 10 sec. It was found that the ZnO film has a similar characteristic curve to an x-ray film. The electrophotographic layer has a higher contrast but the latitude is smaller than in the case of the x-ray film. It follows that small irregularities in the beam are better defined in the electrophotographic method. (OTS)

25010 QUANTITATIVE CHARACTERISTICS OF THE LATENT IMAGE FORMED UNDER THE ACTION OF IONIZING PARTICLES. A. L. Kartuzhanskii (Leningrad Soviet Trade Inst.). Zhur. Nauch. i Priklad. Fot. i Kinematografii, 5: 221-3(1960).

It was found that the reciprocity law breaks down in the case of β-particle induced images. Since it was suspected that this effect is due to regression, an investigation was made of the dependence of this effect on temperature. Three emulsions were exposed using C^{14} and P^{32}. The temperature range investigated was 0 to 40°C. The humidity was kept constant and approximately equal to normal room humidity. It was found that Meikler's equation, $H = H_0/2\ (1 + \sqrt{1 + bt})$, applies and the value of the coefficient b is the same as in the case of light. The numerical values of N_0 and U which enter into the formula for b, namely $b = 4\nu/N_0^2\ e - U/KT$, are given. (OTS)

25011 DOSIMETRIE DER STRAHLUNGEN RADIOAKTIVER STOFFE. (Radiation Dosimetry of Radioactive Materials). Walter Minder. Vienna, Springer-Verlag, 1961. 307p.

The phenomenon of radioactivity and the laws governing it are discussed including the structure of the atom, the nature of radioactive particles, decay processes, and the occurrence of radioactive materials. Interactions between radiation and matter are described. Ionization chambers and counting methods used in measuring radioactivity are described and means of interpreting the results are outlined. Units of radiation dosage are given and defined. The relationship between activity and dosage is explained. Methods of measuring both internal and external irradiation and the principles of dose calculation are discussed. The uses of radioactive materials are summarized. Safety problems and handling methods are reviewed. (M.C.G.)

25012 IMPROVEMENTS IN AND RELATING TO MEASURING SYSTEMS. (to Industrial Nucleonics Corp.). British Patent 873,629. July 26, 1961.

A radiation thickness gage is designed with an amplifier in such a way that the input tube of the amplifier may be replaced with another of different grid characteristics without the necessity for recalibrating the instrument. The amplifier is described in British Patent No. 873,630. (D.L.C.)

25013 IMPROVEMENTS IN AND RELATING TO DIRECT CURRENT AMPLIFIERS. (to Industrial Nucleonics Corp.). British Patent 873,630. July 26, 1961.

A d-c amplifier is described which uses commercial circuit components and is simple to construct and maintain. The amplifier also has means for balancing extreme voltages at the input, and there is no need for a special reference voltage source. The amplifier can be used in ionization chamber type detectors, and a radiation thickness gage using the amplifier is described in British Patent No. 873,629. (D.L.C.)

25014 AIR RADIOACTIVITY MONITOR. R. L. Bradshaw and J. W. Thomas (to U. S. Atomic Energy Commission). U. S. Patent 2,979,620. Apr. 11, 1961.

The monitor is designed to minimize undesirable background buildup. It consists of an elongated column containing peripheral electrodes in a central portion of the column, and conduits directing an axial flow of radioactively contaminated air through the center of the column and pure air through the annular portion of the column about the electrodes. (AEC)

25015 RADIO RANGING DEVICE. J. W. Gratian, A. C. Gratian, H. R. Crane, M. E. Bourns, and R. T. Nieset (to U. S. Atomic Energy Commission). U. S. Patent 2,980,905. Apr. 18, 1961.

A super-generative radar system is described as having alternate phases of transmission and reception and is adapted to transmit for unequal durations in the absence of receiving energy and for equal and longer durations when energy of proper phase is received. (AEC)

25016 ADJUSTABLE DOUBLE PULSE GENERATOR. Joseph W. Gratian and A. C. Gratian (to U. S. Atomic Energy Commission). U. S. Patent 2,994,837. Aug. 1, 1961.

A modulator pulse source having adjustable pulse width and adjustable pulse spacing is described. The generator consists of a cross coupled multivibrator having adjustable time constant circuitry in each leg, an adjustable differentiating circuit in the output of each leg, a mixing and rectifying circuit for combining the differentiated pulses and generating in its output a resultant sequence of negative pulses, and a final amplifying circuit for inverting and square-topping the pulses. (AEC)

25017 MAGNETIC DENSITOMETER. J. A. McCann and R. H. Jones (to U. S. Atomic Energy Commission). U. S. Patent 2,996,662. Aug. 15, 1961.

A magnetic densitometer for locating defects and metallic inclusions in materials is described. The apparatus consists of two primary coils connected in series opposition and adapted to be placed in inductive relation to the material under test, a source of constant frequency alternating current coupled across the primary coil combination, a pick-up coil disposed in symmetrical inductive relationship with said primary coils, a phase-shifter coupled to the output of the energizing source. The output of the phase-shifter is coupled in series with the pick-up coil. An amplifier is provided selective to the third harmonic of the energizing source frequency. The series combination of the pick-up coil and the phase-shifter output are connected across the input of the amplifier, and an amplitude comparitor is coupled to the output of the amplifier and the energizing source for comparing the instantaneous amplitude of the amplifier output and the instantaneous output of the energizing source and producing an output proportional to the difference in amplitude. A recorder is coupled to the output of the amplitude comparison means to give an indication of the amplitude difference, thereby providing a permanent presentation of the character of the changes in characteristics exhibited by the material under test. (AEC)

25018 NEUTRONIC REACTOR CORE INSTRUMENT. L. S. Mims (to U. S. Atomic Energy Commission). U. S. Patent 2,997,587. Aug. 22, 1961.

A multi-purpose instrument for measuring neutron flux, coolant flow rate, and coolant temperature in a nuclear reactor is described. The device consists essentially of a hollow thimble containing a heat conducting element protruding from the inner wall, the element containing on its innermost end an amount of fissionable material to function as a heat source when subjected to neutron flux irradiation. Thermocouple type temperature sensing means are placed on the heat conducting element adjacent the fissionable material and at a point spaced therefrom, and at a point on the thimble which is in contact with the coolant fluid. The temperature differentials measured between the thermocouples are determinative of the neutron flux, coolant flow, and temperature being measured. The device may be utilized as a probe or may be incorporated in a reactor core. (AEC)

25019 ACCELERATION INTEGRATING MEANS. D. F. Wilkes (to U. S. Atomic Energy Commission). U. S. Patent 2,997,883. Aug. 29, 1961.

An acceleration responsive device is described. A housing has at one end normally open electrical contacts and contains a piston system with a first part of non-magnetic material having metering orifices in the side walls for forming an air bearing between it and the walls of the housing; this first piston part is normally held against the other end of the housing from the noted contacts by a second piston or reset part. The reset part is of partly magnetic material, is separable from the first piston part, and is positioned within the housing intermediate the contacts and the first piston part. A magnet carried by the housing imposes a retaining force upon the reset part, along with a helical compression spring that is between the reset part and the end with the contacts. When a predetermined acceleration level is attained, the reset part overcomes the bias or retaining force provided by the magnet and the spring "snaps" into a depression in the housing adjacent the contacts. The first piston part is then free to move toward the contacts with its movement responsive to acceleration forces and the metering orifices. (AEC)

Materials Testing

25020 (ANL-6346) SYMPOSIUM ON PHYSICS AND NONDESTRUCTIVE TESTING, HELD AT ARGONNE NATIONAL LABORATORY, OCTOBER 4-5, 1960. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 208p.

Twelve papers are included which were presented at the Symposium on Physics and Nondestructive Testing. The subject matter of the papers include neutron radiography, elastic waves, ultrasonic waves, magnetic properties, applied mathematics, and accelerator applications. Separate abstracts have been prepared for eleven papers, while the remaining paper was previously abstracted in NSA. (D.L.C.)

25021 (ANL-6346(p.12-37)) NEUTRON RADIOGRAPHY. Harold Berger (Argonne National Lab., Ill.).

Neutron radiography is considered with regard to the problems of the production of the neutron beam and neutron image, and the photographic detection of the neutron image. Neutron sources, the neutron absorption of materials, and an over-all comparison of the various methods of detecting a neutron image are discussed. (auth)

25022 (ANL-6346(p.109-26)) ULTRASONIC ATTENUATION AND THE PHYSICS OF SOLIDS. Rohn Truell (Brown Univ., Providence).

An outline is given of those interactions between ultrasonic stress waves in solids and the various types of absorbing or scattering elements which can be studied by observing the propagation behavior of the stress waves. A discussion is given of what can be learned about solids and defects in solids from the physical point of view. Specific examples related to changes in mechanical properties and changes induced by radiation effects are given. (auth)

25023 (ANL-6346(p.127-38)) THE DIFFUSION OF PULSED CURRENT FIELDS IN GOOD CONDUCTORS. C. J. Renken (Argonne National Lab., Ill.).

The use of pulsed fields in electromagnetic testing is a fairly recent development. This technique offers a number of theoretical and practical advantages over methods which use steady-state sinusoidal fields. It is possible to utilize fields of small cross-sectional area to produce electromagnetic test systems of improved resolution. The relatively slow rate of diffusion of current fields in good conductors makes possible the time separation of reflections from the surface of the metal and from internal discontinuities. (auth)

25024 (ANL-6346(p.154-63)) MATHEMATICS IN NONDESTRUCTIVE TESTING. W. F. Miller (Argonne National Lab., Ill.).

A survey of the role of mathematics and computers in the problems of nondestructive testing is presented. A discussion is given of those problems which reduce to classical problems of applied mathematics. Estimates are given of typical computer capacities and the times needed to handle many of these typical problems. (auth)

25025 (ANL-6346(p.164-75)) STATISTICAL METHODS. J. W. Butler (Argonne National Lab., Ill.).

Nondestructive testing often involves quantitative measurements which must be processed by statistical methods. There is then a choice to be made between point estimation, interval estimation, and hypothesis testing. Factors involved in this choice are discussed, and all three techniques are applied to an idealized radioactivity thickness gage of the transmission type. The possible role of automatic computing machines is also examined. (auth)

25026 (ANL-6346(p.176-96)) THE SCIENTIFIC APPLICATION OF PARTICLE ACCELERATORS TO NONDESTRUCTIVE TESTING. E. Alfred Burrill (High Voltage Engineering Corp., Cambridge, Mass.).

The high-energy particles and radiations obtainable from particle accelerators are broadly useful in the field of nondestructive testing. The applications of supervoltage and high-energy x rays for radiography are numerous and well explored. The possible use of positive ions and neutrons, on the other hand, has not been investigated to any appreciable extent. The physical characteristics of phenomena involving positive ions and neutrons and their interaction with matter are described. Nondestructive testing methods arising from understanding of these phenomena are suggested, including continuous activation analysis of production flow, neutron radiography, and the analysis of surfaces and thin coatings. (auth)

25027 (HW-SA-2179) NONDESTRUCTIVE TESTING OF ZIRCALOY REACTOR PROCESS TUBES FOR HIGH PRESSURE, TEMPERATURE SERVICE. Richard B. Socky (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 11, 1961. Contract AT(45-1)-1350. 33p.

A discussion is given of the methods used in the nondestructive testing of the structural integrity of Zircaloy tubes for use in reactors at high pressures and temperatures. Test results show that the integrity of the tubes can be evaluated, and that Zircaloy-2 appears to be a satisfactory tube material. (B.O.G.)

25028 (NAA-SR-Memo-6396) THE RELATION OF TRANSVERSE RUPTURE STRENGTH TO ULTIMATE TENSILE STRENGTH FOR Zr HYDRIDES. J. W. Raymond (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 10, 1961. 5p.

A method of determining transverse plastic set at rupture load is introduced. The result, when incorporated in a variation of the flexure equation, relates the transverse rupture strength to ultimate tensile strength. The method, when applied to delta phase zirconium hydride, indicated that at room temperature transverse rupture strength and ultimate tensile strength are numerically identical. (auth)

25029 (NUMEC-P-31) DESIGN STUDY OF THE MEASUREMENT OF THERMAL CONDUCTIVITY OF POOR CONDUCTORS AT HIGH TEMPERATURES BY THE USE OF POINT AND UNIFORM PLANE SOURCES OF HEAT. Eber K. Halteman (Nuclear Materials and Equipment Corp., Apollo, Penna.). June 2, 1961. Contract AT(30-1)-2389. 20p.

The unique features of this method are the use of a point or uniform plane source of heat produced by an electron beam, simple sample geometry, small sample size, readily obtainable boundary conditions, and ease of experiment assembly because of the absence of thermocouple wires or internal heaters in association with the sample. High sublimation rate and loss in sample strength or susceptor as melting points are approached are limiting factors. (J.R.D.)

25030 ULTRASONIC FLAW DETECTION METHOD AND MEANS. Daniel C. Worlton (to U. S. Atomic Energy Commission). U. S. Patent 2,995,925. Aug. 15, 1961.

A method of detecting subsurface flaws in an object using ultrasonic waves is described. An ultrasonic wave of predetermined velocity and frequency is transmitted to engage the surface of the object at a predetermined angle of incidence thereto. The incident angle of the wave to the surface is determined with respect to phase velocity, incident wave velocity, incident wave frequency, and the estimated depth of the flaw so that Lamb waves of a particular type and mode are induced only in the portion of the object between the flaw and the surface. These Lamb waves are then detected as they leave the object at an angle of exit equal to the angle of incidence. No waves will be generated in the object and hence received if no flaw exists beneath the surface. (AEC)

GEOLOGY, MINERALOGY, AND METEOROLOGY

25031 (KY-373) VARIATIONS IN ISOTOPIC CONTENT OF NATURAL URANIUM. R. F. Smith, R. E. Eby, and C. W. Turok (Union Carbide Nuclear Co. Paducah Plant, Ky.). June 26, 1961. Contract W-7405-eng-26. 9p.

Uranium ore concentrates from seventeen world sources were compared to a standard to determine variations in isotopic content. A spread of about 0.06% in U^{235} content was indicated for the concentrates analyzed. Domestic sources showed much wider variations than those from other parts of the world. (auth)

25032 (NYO-2712) AN INVESTIGATION OF THE CHEMICAL NATURE OF THE ORGANIC MATTER OF URANIFEROUS SHALES. Annual Report Covering the Period January 1, 1959 to December 31, 1960. C. R. Kinney and Leo J. Duffy (Pennsylvania State Univ., University Park. Coll. of Mineral Industries). Apr. 21, 1961. Contract AT(30-1)-1442. 129p.

Submitted as a thesis by Leo J. Duffy.

The character of the organic matter of Chattanooga shale kerogen was determined by studying the products obtained by oxidation of the shale and kerogen with concentrated nitric acid. A violent reaction, which was partly caused by pyrite, occurred on treating the raw shale with concentrated nitric acid, but considerable oxidation occurred as evidenced by the 35.7 and 5.8% of the total carbon appearing as carbon dioxide and acetic acid, respectively. A method was developed in which large samples of shale were extracted with hydrofluoric and nitric acids to give a sample of kerogen containing 1 to 3% ash in a relatively short period of time. To avoid foaming of reaction mixture, a two-stage oxidation procedure was developed which consisted of first treating with concentrated nitric acid at 75°C for one hour followed by retreatment of the products insoluble in dilute nitric acid with concentrated nitric acid at reflux for one hour. The acids insoluble in dilute nitric acid from both the first and second stages were shown to be nitrated and oxidized to a considerable extent. Equivalent weights of 211 and 159 were found for the acids from the first and second stages respectively compared with an equivalent weight of 776 for the kerogen. Infrared spectral data, atomic hydrogen/carbon ratios, and empirical formulas, calculated from the chemical analyses, showed that the acids were a complex mixture containing both aliphatic and aromatic components. The 75°C soluble acids, isolated in the first stage, and the 120°C soluble acids, isolated from the second state, appeared to be composed of principally aliphatic structures. Free sulfuric acid which was found in both of the acids is assumed to have originated from organic structures since no sulfate was observed in either the kerogen or the insoluble acids. An equivalent weight of 277 was observed for the 75°C soluble acids and 144 for the 120°C soluble acids. Hydrogen/carbon ratios of 1.28 and 1.17 were observed for the 75 and 120°C soluble acids, respectively, while the oxygen/carbon ratio of the 120°C acids, 0.45, was higher than that of the 75°C soluble acids, 0.28. Infrared spectra and empirical formulas of both acids emphasized the predominantly aliphatic character. They are thought to be composed of predominantly alicyclic, which may contain unsaturated linkages, and/or unsaturated open-chain organic structures. It is estimated that from 60 to 70% of the carbon in the organic matter of Chattanooga shale is of an aliphatic nature. (auth)

25033 (UCRL-13008) SOURCES OF INFORMATION ON ROCK PHYSICS. Current Literature, May 1961. Lorraine Burgin (Colorado School of Mines Research Foundation, Inc., Golden). May 29, 1961. For Univ. of California Lawrence Radiation Lab. 54p.

A bibliography is presented consisting of 132 references to current literature and future symposia pertaining to the field of rock physics, rock mechanics, wave propagation, and related subjects. The references are arranged alphabetically by authors. (B.O.G.)

25034 (UCRL-13012) SOURCES OF INFORMATION ON ROCK PHYSICS. Current Literature June 1961. Lorraine Burgin (Colorado School of Mines Research Foundation, Inc., Golden). June 30, 1961. For Univ. of California, Lawrence Radiation Lab. 71p.

Literature pertaining to the field of rock physics, rock mechanics, wave propagation, and other related subjects was reviewed. Two hundred and forty four references, listed in alphabetical order by author, are presented along with a synopsis of the article. (M.C.G.)

25035 (AEC-tr-4615) AN INVESTIGATION OF THE ISOTOPIC COMPOSITION OF URANIUM IN RARE EARTH MINERALS. Yu. A. Surkov, A. A. Vorob'ev, V. A. Korolev, and V. D. Vilenskii. Translated from Atomnaya Energ., 9: 477-82(1960). 12p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 6218.

25036 THE AGE OF A NUMBER OF SPECIMENS OF THE QUATERNARY PERIOD FROM RADIOCARBON DATING. I. E. Starik and Kh. A. Arslanov. Doklady Akad. Nauk S.S.S.R., 138: 102-5(May 1, 1961). (In Russian)

Sixteen samples of Quaternary deposits of peat and lignin from the European part of the SSSR were analyzed for C^{14} on a scintillation counter by beta coincidence counting. Ethylbenzene or benzene were synthesized from the carbon in the samples, and used as solvents in the scintillation counter. Due to the limited amount of sample available, contaminating humic acids were not previously removed with a caustic treatment, but cross-checks showed that in most cases humic acid contamination by ground water was absent. The samples varied in age from 3050 to 42,700 years. The results of radiocarbon dating agreed with spore and pollen analyses of the sample. The older samples indicate formation of the deposit 30,000 to 42,000 years ago. The data are compared with the radiocarbon dating of ocean core samples and samples of the various Wisconsin ice ages. (TTT)

25037 A NEW PHOSPHATE MINERAL FROM THE SPRINGWATER PALLASITE. E. R. DuFresne (Univ. of Chicago) and S. K. Roy. Geochim. et Cosmochim. Acta, 24: 198-205(July 1961). (EFINS-60-54). (In English)

Springwater contains substantial amounts of anhydrous magnesium phosphate, a new mineral. The phosphate is in contact with the iron and was in contact with it at the time of solidification of the meteorite. From the physical properties and chemical reactions of the two phases it can be inferred that the cooling through the freezing range was rapid. The optical properties and physical description of the mineral are presented, together with chemical analyses and the x-ray diffraction pattern. The discussion of the analyses permits the conclusion that SiO_2, FeO, and excess

MgO can be contained in solid solution by the phosphate mineral. (auth)

25038 ISOTOPIC GEOCHEMISTRY OF URANIUM AND LEAD IN THE SWEDISH KOLM AND ITS ASSOCIATED SHALE. James C. Cobb and J. Laurence Kulp (Columbia Univ., New York). Geochim. et Cosmochim. Acta, 24: 226-49(July 1961). (In English)

The uranium and lead concentration and isotopic composition in a variety of samples of kolm and associated black shale from the Peltura beds (Franconian stage) of the Upper Cambrian of Sweden were determined by isotope dilution techniques. In addition Th^{230}, Ra^{226}, Pb^{210}, and radon leakage values were determined on certain samples. All samples show discordant U–Pb isotopic ages. It appears that two processes were at work; selective removal of Pb^{206}, resulting from the movement of an intermediate member of the U^{238}–Pb^{206} series, and removal of bulk radiogenic lead. The absolute age of the formation is concluded to be greater than 500 million years with the most probable age near this lower limit. This is in good agreement with the latest results on the absolute geologic time scale. The stratigraphically well-dated kolm cannot, however, be considered a calibration point in the absolute time scale. It does show that uranium-lead dating on bituminous shales will lead to minimum ages for these formations. (auth)

25039 THE CONCENTRATION AND ISOTOPIC ABUNDANCES OF CARBON DIOXIDE IN RURAL AND MARINE AIR. Charles D. Keeling (California Inst. of Tech., Pasadena). Geochim. et Cosmochim. Acta, 24: 277-98(July 1961). (In English)

The concentration and isotopic abundances of C^{13} and O^{18} of carbon dioxide in rural air are extended by reporting the analysis of 106 additional samples of rural air and thirteen samples of air collected over tropical waters of the eastern Pacific Ocean. At locations far removed from terrestrial plants and the influence of cities, the concentration and C^{13} abundance of carbon dioxide in the air are found to be nearly constant; but the O^{18} abundance of carbon dioxide, under various circumstances, appears to show a systematic variation with air temperature, ocean water temperature, or season. Extreme values are, concentration: from 0.0303 to 0.0320 volume per cent of original air; C^{13}/C^{12} ratio: from −6.7 to −7.4 per mil; O^{18}/O^{16} ratio: +0.8 to −0.6 per mil. A correlation between C^{13} abundance and concentration of carbon dioxide previously observed for forest air is again observed. On the basis of this correlation, the C^{13}/C^{12} ratio of the carbon dioxide released by the forest plants is computed and is found to vary for different stations between −21 and −26 per mil. The O^{18} abundance of carbon dioxide in forest air is observed to be variable but shows no simple relationship with other measured quantities. (auth)

25040 A MECHANISM FOR CYCLIC ENRICHMENT OF CARBON-12 BY TERRESTRIAL PLANTS. Charles D. Keeling (California Inst. of Tech., Pasadena). Geochim. et Cosmochim. Acta, 24: 299-313(July 1961). (In English)

A model is described which predicts that variations in the relative abundance of C^{12} and C^{13} in terrestrial plants may be due in part to varying degrees of local cycling of carbon dioxide gas. The model emphasizes the effectiveness of transient departures from a steady state in achieving cyclic enrichment, and predicts that cyclic enrichment should be limited by the maximum concentration of carbon dioxide occurring near the plants during their diurnal cycle. Experimental data are discussed which support the model. (auth)

25041 MEASUREMENTS OF CESIUM-137 IN RAIN WATER WITH A SCINTILLATION SPECTROMETER. Tsunenobu Terasaki, Yoshihyki Yamanobe, and Hachiro Niizeki (Yamagata Univ., Yamagata, Japan), J. Radiation Research (Japan), 1: 91-7(Sept. 1960). (In English)

Measurements of Cs^{137} in rain water were made in 1958 by gamma scintillation spectroscopy. The average monthly quantity in 1958 was estimated as 0.99 mc/km^2 per month while it was 0.3 mc/km^2 per month in 1957. The amount of precipitation in 1958 was 1.7 times that of precipitation in 1957, the content of Cs^{137} increased more than 3 times during the same period. (auth)

25042 MEASUREMENT OF FALLOUT CESIUM IN THE PACIFIC OCEAN AND IN TERRESTRIAL EFFLUENTS LIKELY TO ALTER COASTAL WATERS. T. R. Folsom (Univ. of California, La Jolla) and G. J. Mohanrao. J. Radiation Research (Japan), 1: 150-4(Sept. 1960). (In English)

A chemical technique is developed for concentrating traces of fall-out Cesium-137 in sea water (and in sewage) so that assay can be made rapidly with a gamma ray spectrometer. Measurements are made of Cs^{137} in surface waters of the eastern Pacific, especially near shore, and data are compared with fall-out contamination reported elsewhere. Also a contemporary vertical profile of Cs^{137} activity in the Pacific is given. The behavior of fall-out activity in a large modern sewage treatment plant and in its oceanic out-fall are discussed, and estimates are made of the probable effects in coastal areas. (auth)

25043 ELECTRON CLOUDS: A GENERAL SURVEY. F. F. Marmo, J. Pressman, and L. M. Aschenbrand (Geophysics Corp. of America, Boston). Planetary and Space Sci., 3: 139-57(1961).

The results and analysis of seven rocket experiments designed and performed to study systematically the physics of the generation of artificial electron clouds in the upper atmosphere are summarized. The first involved the daytime Aerobee rocket release of potassium at 121 km and served to establish the feasibility of solar photoionization generation of artificial electron clouds. The second phase was the Nike-Cajun night-time release of cesium at 101 km to establish the role of thermo-chemical generation of electron clouds. The third phase was designed to study the correlation of optical and radio-radar data as obtained from a visible, photographic electron cloud. This was accomplished by the morning twilight releases of cesium and sodium at 128 km and 116 km, respectively. The final phase of this series reported involved three releases of cesium at 91 km, 82 km, and 69 km, in order to determine the altitude below which long-lived, dense artificial electron clouds cannot be generated by the techniques employed. The results of this last phase yield valuable physical data pertinent to several of the electron decay processes dominant in the lower altitudes. The over-all analysis of the extensive optical and radar data has yielded information on the following physical parameters: chemical yield of contaminant, thermal ionization efficiency, upper atmospheric wind velocity, wind shear, optical and Gaussian half-width of cloud with time, ambipolar diffusion, neutral diffusion, photoionization cross-sections, mutual neutralization processes, and rate of chemical consumption of alkali by atmospheric oxygen. Finally, the role that artificial electron clouds can assume for practical utilization for radio-radar propagation is emphasized with some discussion indicating the extent of the available potential for this engineering purpose. (auth)

25044 URANIUM AND OTHER METALS IN CRUDE OILS. A. METHODS OF ANALYSIS FOR URANIUM AND OTHER METALS IN CRUDE OILS, WITH DATA ON RELIABILITY. C. A. Horr, A. T. Myers, P. J. Dunton. B. DISTRIBUTION OF URANIUM AND OTHER METALS IN CRUDE OILS. Harold J. Hyden. (Geological Survey, Washington, D. C.). Geological Survey Bulletin 1100. 1961. 126p.

A. The content of uranium and other metals in crude oils ranges from a few tenths to several hundred parts per million. To concentrate these metals, crude-oil samples were prepared for analysis and reduced to ash by two methods: a modified ASTM method of dry ignition, and a wet oxidation followed by ashing. Results obtained by the two methods do not differ appreciably. The concentration of copper, vanadium, and nickel in the ash of 37 oils was determined by both the quantitative and semiquantitative spectrochemical procedures. A comparison of the results showed that more than 60% of the semiquantitative results for these three elements are in the same one-third order of magnitude as the quantitative results. Uranium in the ash was determined fluorimetrically and comparative results on several samples showed satisfactory agreement.

B. A total of 120 samples of crude oil and 16 samples of refinery residue were collected from oil fields and refineries located in the western half of the United States. The oil and residue samples were reduced to ash; the uranium content of the ash was determined by fluorometric analysis, and the content of other metals by emission spectrograph. The uranium content in the ash of a majority of the samples is included in the range 0.0002 to 0.001%. The reported average uranium content in the crust of the earth is within this percentage range. In contrast, vanadium and nickel contents in the ash of most of the samples are included in the range of 10 to 50%, which is several orders of magnitude greater than the reported vanadium and nickel contents in the crust of the earth. The amounts of other metals in the ash of oil are similar to those in the crust of the earth; among these latter metals, molybdenum shows the greatest relative enrichment in the ash of crude oil. The ratios of vanadium to nickel of the oil samples tend to increase with increasing age of reservoir rock. Tests indicate that crude oil can leach uranium from sandstone containing uranium minerals such as uraninite and carnotite. The uranium content of crude oils, therefore, can be indicative of the uranium content in sandstone oil reservoirs. (auth)

HEALTH AND SAFETY

25045 (AD-254071) THE INFLUENCE OF A FIRE-INDUCED CONVECTION COLUMN ON RADIOLOGICAL FALLOUT PATTERNS. Technical Paper No. 32. A. Broido and A. W. McMasters (Forest Service. California Forest and Range Experiment Station, Berkeley). Mar. 1959. 52p.

A theoretical and small-scale experimental study was undertaken to see if fire-induced convection columns could significantly affect fallout patterns. Experiments were conducted in a 6- by 6-ft low-velocity wind tunnel using full-scale fallout simulants. Values of characteristic parameters of fallout patterns were compared for experiments conducted with and without fire, all other factors being held constant. As predicted by theory, a fire upwind of the region of deposition introduced a further downwind movement and lateral dispersion of the fallout. In a few experiments in which the fire was located at the edge of the no-fire pattern, air flow into the convection column shifted the pattern peak upwind. These results suggest quite strongly that effects which can markedly alter civil defense planning will be found for large-scale fires. (auth)

25046 (FZK-110(Suppl.1)) HAZARDS SUMMARY REPORT FOR THE NUCLEAR SCIENCE CENTER. R. B. Cochran (Texas. Agricultural and Mechanical Coll., College Station). [1960]. 134p.

Organizational, design, and functional modifications to the proposed reactor facility at Texas A. and M. are described. Authorization to operate the reactor at an initial 100 kw power level and provisional authorization to operate at a full power of 5 Mw is sought. An addition to the site of a high-level gamma irradiation facility is proposed. The reactor pool, originally proposed as two sections, was elongated to provide a third section, which will be used for future expansion. In addition to the originally requested 0.7%, 1.0% excess reactivity is requested for 100 kw operation. The philosophy of controls and instrumentation was altered to eliminate much of the complex interlock system originally proposed. The reactor building was modified to raise the height of the roof 15 ft. It was concluded that neither primary coolant pump failure nor municipal power failure would lead to any significant problems or to any potential radiation hazard. Operation and emergency procedures are outlined. (M.C.G.)

25047 (IDO-16623) HAZARDS EVALUATION OF PROPOSED SITE FOR ETR II (NOW DESIGNATED ATR). D. R. deBoisblanc, R. J. Nertney, and L. H. Jones (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Aug. 18, 1960. Contract AT(10-1)-205. 81p.

An analysis is presented of the suitability, from the point of view of mutual interactions with existing reactors, of the proposed site of the ETR II on the National Reactor Testing Station at the northwest corner of the present MTR-ETR complex. The various modes of interaction between the three reactors were analyzed in terms of the experience that was gained in the operation of the MTR and ETR in close proximity over the last three years. Extensive measurements were made of the radioactive material distributed in the vicinity of the MTR and ETR reactors and their stacks during normal operation and upon occurrences of unexpected incidents. These measurements cover a continuous period of three years and cover the types of meteorological conditions which prevail at this particular location. It is concluded that ETR II can be located and operated in the proposed location with negligible interference with the present reactors, or loss of ETR II operating time due to events occurring in the MTR and ETR. (auth)

25048 (NAA-SR-Memo-6269) NUCLEAR CHEMICAL PLANT DESIGN—CRITICALITY CONSIDERATIONS. Norman Ketzlach (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 18, 1961. 21p.

Criticality considerations in the design of nuclear chemical plants are presented. Emphasis is placed on the need for understanding the bases of theoretical calculations and experimental criticality data, as well as the process variables, as prerequisites to establishing nuclear safety criteria. Examples are presented of the effects of several variables on criticality. Plant design is also considered. (auth)

25049 (NARF-61-1R) TORY-IIA EFFLUENT SAMPLING PROGRAM. VOLUME I. A PRELIMINARY DIFFUSION STUDY AT THE NEVADA TEST SITE. (Convair, Fort Worth, Tex.). Jan 31, 1961. Contract AF33(600)-38946. 135p. (FZK-9-158; AD-253767).

A series of 17 tracer releases was made at the TORY-IIA test site in Nevada to investigate atmospheric diffusion characteristics over rough terrain and to evaluate the design of the effluent-sampling network. The test site, sampling equipment, and meteorological instrumentation are described, and experimental data are presented on the atmospheric dispersal of the Zn(Cd)S tracer aerosol. (auth)

25050 (NP-10390) ANNUAL PROGRESS REPORT ON BIOLOGICAL ASPECTS OF RADIATION, JULY 1, 1960—JUNE 30, 1961. Charles O. Onstead, Frank V. Keary, and Erich Oberhausen (Army Medical Research Unit No. 1, Landstuhl Army Medical Center, Germany). 17p.

A 2 π liquid scintillation whole-body counter was used to study the radioactivity in man. More than three thousand normal subjects were measured. An improved method of instrument calibration was devised. The Cs^{137} concentration was found to be decreasing at a rate equivalent to a half-life of 15 to 16 months. The instrument is also being used to study individuals contaminated with radium and thorotrast, and as an aid in clinical diagnosis. (auth)

25051 (TID-3551(Rev.1)) RADIATION PROTECTION STANDARDS. A Literature Search. William E. Bost, comp. (Office of Technical Information Extension, AEC). June 1961. 44p.

Included are 538 references to reports and published literature written since 1957. For convenience in abstract scanning, NSA reference numbers are provided when possible. (P.C.H.)

25052 DETERMINATION OF RAD/R RELATIONSHIP FOR BONE AND MUSCLE USING THE METHOD OF GAS EQUIVALENTS. RESULTS FOR LOW ENERGY X-RAYS. Anne-Marie Roux and A. Allisy (Laboratoire de Dosimetrie, Paris). Ann. radiol., 4: 387-92(1961). (In French)

The method of gas equivalents was used to study the absorbed dose-exposure dose relationship in bone and muscle for very soft x rays. The x-ray source was a tube with a beryllium window, running at constant voltage varying from 10 to 40 kv. The measurement of the ionization produced in air and argon was carried out using a parallel plate calibration chamber. Estimations were carried out

on various mixtures of air and argon in order to obtain a conversion for the incident photon energy into electron energy analogous to that which takes place in bone and muscle. (auth)

25053 DETERMINATION OF RADIOACTIVITY IN WATER SAMPLES OF CISTERNS IN SCHLESWIG-HOLSTEIN. H. Knapstein. Landwirtsch. Forsch., 13: 219-23(1960).

The preparation and sampling of cistern water for the detection of total β activity are described. Water from 2 cisterns tested in 1959 showed values of 23.3 to 405.0 $\times 10^{-12}$ c/l. Ten cisterns tested since August 1959 gave values between 5.0 and 77.0 $\times 10^{-12}$ c/l. Rather than the quantity of radioactivity in precipitations, the values depend more on the total content of water in the cisterns. (P.C.H.)

25054 SANITARY-HYGIENIC REQUIREMENTS AND STANDARDS OF NEW SANITARY REGULATIONS CONCERNING WORK WITH RADIOACTIVE SUBSTANCES AND SOURCES OF IONIZING RADIATION. P. I. Moiseitsev. Med. Radiol., 6: No. 4, 3-9(Apr. 1961). (In Russian)

Sanitary-hygienic requirements and standards for new sanitary regulations pertinent to handling radioactive substances or sources of ionizing radiation, issued on the 25th of June, 1960, by the Ministry of Public Health of the USSR and the State Committee of the Council of Ministers for the Use of Atomic Energy are given. (auth)

25055 RADIATION MONITORING FOR THE PROTECTION OF PERSONNEL. Nuclear Eng., 6: 285-98(July 1961).

A review is presented of the manufacturers and specifications of radiation monitoring devices for personnel protection. Listings are given of β, γ, and n film badges; pocket dosimeters; liquid monitors; hand and foot monitors; neutron monitors; α, β, and γ monitors; and radioactive dust monitors. (T.F.H.)

25056 FUNDAMENTAL STUDIES ON PHANTOMS FOR DEPTH-DOSE MEASUREMENT. Tosio Irie (Osaka City Univ.). Ôsaka Shiritsu Diagaku Igaku Zasshi, 9: No. 10, Suppl. 3, 3663-84(Oct. 1960). (In Japanese)

The performance of phantoms of water, paraffin, wax, whale meat, gelatin, and wax mixtures was compared for radiation depth-dose measurements. The gelatin phantom gave best results. (C.H.)

25057 RADIOACTIVITY OF LUMINOUS WATCHES AND ESTIMATION OF DOSE TO THE WRIST AND THE GONADS. A. Eikodd, A. Reistad, A. Storruste, and J. Synnes (Inst. of Physics, Univ. of Oslo, Blindern, Norway). Phys. in Med. Biol., 6: 25-31(July 1961).

The dose distribution in the arm due to a luminous wrist watch was calculated and is shown in graphical form. The theoretical values are compared with those measured in a phantom. The gamma activity of 165 watches was measured, and the average activity was found to be 0.13 μg radium. The amount of radon leaking out of the watches in ten hours varies from around 1×10^{-10} curie per μg radium for watertight watches to around 3×10^{-8} curie per μg radium for loosely sealed watches. The measured gonad dose for male persons is 0.012 mrad/hr for 1 μg radium on the watch. (auth)

25058 THE CONTRIBUTION OF DIAGNOSTIC RADIOLOGY TO POPULATION DOSE. B. W. Windeyer. p.99-103 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Present practices in diagnostic radiology and the use of radiotherapy in non-malignant conditions are reviewed. Radiation hazards from various types of examinations are discussed. It is concluded that medical radiology is the greatest contributor to radiation dose in excess of natural background, and that unnecessary exposure should be reduced wherever possible. (C.H.)

25059 BRITISH SURVEY OF THE RADIATION DOSE TO THE POPULATION FROM MEDICAL RADIOLOGY. 1. FIELD SURVEY FOR DIAGNOSTIC RADIOLOGY. S. B. Osborn (Univ. Coll. Hospital, London). p.103-18 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English).

Measurements were made of radiation dose to the gonads during 5000 diagnostic x ray examinations. Results are compared with measurements on a phantom using an ionization chamber connected to an electrometer. A circuit diagram for the electrometer is included. (C.H.)

25060 GONAD DOSE RESULTING FROM MEDICAL USE OF IONIZING RADIATION IN FRANCE. J. Reboul. p.118-27 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In French)

A study of the gonad dose resulting from the diagnostic and therapeutic use of ionizing radiations in France is reported. An evaluation method, valid for both types of medical utilization, is developed and described. A statistical survey is made of the radiological exposures distributed according to the age and sex of the patients. From this statistical summary the gonad dosage was determined. Results are tabulated. (J.S.R.)

25061 GENETICALLY EFFECTIVE DOSE FROM MEDICAL RADIATION USE IN A LARGE CITY POPULATION. H. Holthusen. p.127-32 of "IXth International Congress of Radiology. Vol. 1." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

The results of an investigation made in Hamburg to establish the genetic radiation level from medical radiation applications are summarized. Examples are given of the frequency distribution curves obtained in the statistical analysis. Reasons for deviations in the Hamburg gonad dose from that calculated for the English population are discussed. (J.S.R.)

25062 VIEWS ON THE NEW RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. Rolf M. Sievert. p.1131-2 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

In order to allow for the demand of a very high degree of safety, the maximum permissible doses recommended by the ICRP are fixed at low levels as compared with those known to cause harmful effects. Several reasons are given as to why international consideration of the basic principles of radiation protection is desirable. (P.C.H.)

25063 THE DOSE TO TISSUES OF THE BODY FROM NATURAL BACKGROUND RADIATION. F. W. Spiers (Univ. of Leeds, Eng.). p.1133-40 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

A review of background dose levels and discussion of population dose in 3 large cities in Scotland are presented. The sources of radiation in man's environment are mainly the members of the U and Th series, K^{40}, and cosmic rays. The gonadal dose from internal sources is provided mostly

by the potassium content of tissues. This dose rate is estimated to be 21 m rad per year. The dose rate produced by C^{14} in tissues is estimated at 1.6 m rad per year, assuming an equilibrium concentration of 7.21×10^{-12} c per g of carbon. Cosmic ray dose rates are given for various sections of the world and under various conditions. Dose rates from Ra are very small. (P.C.H.)

25064 THE TOTAL ALPHA ACTIVITY OF HUMANS. H. Muth and E. Oberhausen (Max-Planck-Institut für Biophysik, Frankfurt am Main and Universität des Saarlandes, Homburg/Saar, Ger.). p.1140-5 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

Investigations on the natural radium (Ra^{226}) content of humans and of food materials and drinking water have been conducted for a long time. Recent results by Turner, Radley, and Mayneard show that products of the thorium series are also of significance with respect to the natural radiation effect "from within." This statement is in opposition to the earlier results of Hursh et al., who could detect no alpha activity of the thorium series in human bone ashes. For clarification of these opposing statements, new measurements of the total alpha activity both from crematorium and also bone ashes, in which the Ra^{226} content was known from previous measurements, were carried out. The measurement arrangement represents a further development of the method used by Turner et al. and permits, under given assumptions, a separation of the alpha-emitting products of the thorium series from those of the radium series. The results of the measurement of the total alpha activity confirm completely the results of Turner. The total alpha activity of the ashes of human bones is 10^{-13} c/g of ashes and is an order of magnitude higher than the pure Ra^{226} content. For the determination of the ratio of the products of the thorium series to the total alpha activity, further measurements were carried out. The significance of these results for the evaluation of the natural radiation effect is discussed. (tr-auth)

25065 GROWTH AND DEVELOPMENT OF HEALTH PHYSICS AND RESPONSIBILITIES IN THE FIELD OF RADIATION PROTECTION. Karl Z. Morgan (Oak Ridge National Lab., Tenn.). p.1146-55 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Health physics as an organized profession began with the assistance of radiologists and physicists who were concerned with the measurement of radiation dose and the various problems of radiation protection. The common objective of all health physicists is to protect man from the hazards of radiation. They believe that all radiation is harmful and exposures should be kept at the lowest practical level. (P.C.H.)

25066 ORGANIZATION AND CONTROL OF RADIATION PROTECTION IN THE UNITED KINGDOM. W. Binks. p.1155-61 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Deciding on various permissible radiation levels is the first step toward radiation control. At present a national radiation protection policy regarding the co-ordination of advisory services, experimental facilities for determining radiation levels, and training of personnel, including radiation safety officers, is being considered. A certain amount of legislative control of radiation is necessary. In 1957 a "Code of Practice for the Protection of Persons Exposed to Ionizing Radiations" was issued. Regarding external radiation, a high accuracy is obtained by means of films. A new film is being introduced that carries a highly sensitive, strippable emulsion on one side and a less sensitive emulsion on the other. For x rays of the quality used in diagnostic radiology, doses between 1 mrad and 100 rads can be detected, and for radium γ rays the range is 10 mrads to 100 rads. Monitoring of internal radiation is either by direct measurement of individuals or indirect measurement of traces of radioactivity in biological materials such as urine. All body measurements are made in a laboratory constructed in chalk soil with a cavity 8 ft × 8 ft × 6 ft, lined with lead $\frac{1}{4}$ in. thick. The apparatus consists of a scintillation spectrometer, comprising 4 large thallium-activated NaI crystals, coupled through photomultipliers to a 100 channel pulse analyzer. This and other equipment are used to measure small quantities of radioactive materials in air, water, sewage and dust from fall-out fission products. (P.C.H.)

25067 THE ORGANIZATION FOR PROTECTION AGAINST THE HAZARDS OF IONIZING RADIATION IN FRANCE. L. Bugnard. p.1161-7 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In French)

A survey is given of the protective measures taken in France against ionizing radiations. The present laws controlling radiation sources are reviewed. The measures designed to assure the protection of persons professionally exposed and the general population are then summarized. (J.S.R.)

25068 MEASURES FOR PROTECTION AGAINST IONIZING RADIATION IN ITALY. Franco Fossati. p.1167-72 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In French)

The principal characteristics of the technical recommendations and the judicial standards adopted in Italy to encourage, promote, and guarantee protection against radiation are reported. (tr-auth)

25069 EXPERIENCE WITH PRACTICAL RADIATION PROTECTION CONTROL. H. Langendorff. p.1173-5 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

The results from personnel monitoring using film badges in the German Republic are briefly summarized. (J.S.R.)

25070 SIMPLE RESULTS OF HAMBURG STATISTICS FOR ESTABLISHMENT OF THE GENETICALLY EFFECTIVE GONAD DOSE. W. Leppin (Allgem. Krankenhaus St. Georg, Hamburg). p.1176-9 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

In treating radiological data, the UNO formula for the yearly effective gonad dose was used. Uncertainties in the statistical evaluation of the equation magnitudes are discussed, and the methods used to avoid these errors are indicated. (J.S.R.)

25071 GONAD-DOSES IN ROENTGEN DIAGNOSTICS. E. Hammer-Jacobsen (Rigshospitalet, Copenhagen and Radium Centre, Copenhagen). p.1179-80 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Although x-ray examinations were found to be frequent after 45 years of age, great variations were found in the different forms of examinations. When selecting a period for analysis, allowance must be made for seasonal fluc-

tuations. In Copenhagen examinations reached a peak during Feb. and Sept., with the lowest limit being reached during May and Nov. All measurements of gonad doses were performed by Kondiometer condenser chambers. The chambers were from 6 to 45 mm in diameter. Measuring ranges were 0.2 mr to 45 r. The condenser chambers in rubber fingerstalls were placed on the scrotum for men and in the rectum for women. In examinations of gonad doses of less than 5 mr in women (skull, chest, teeth, etc.), the chambers were placed on the abdomen and the ovarian dose was calculated on the basis of the skin dose. A Mix D Phantom with built-in pelvis, lumbar spine, and upper femora was produced to calculate ovarian dose in comparison with rectal dose. To estimate foetal gonad doses in pelvimetry and obstetrical survey of the abdomen, a Mix D Phantom with built-in foetal skeleton and a built-in maternal skeleton were produced. Calculations of genetically significant doses are not yet complete. (P.C.H.)

25072 AN ESTIMATE OF DOSE TO THE GONADS FROM RADIOACTIVE ELEMENTS PRESENT IN FOOD OR WATER. Walter S. Snyder (Oak Ridge National Lab., Tenn.). p.1242-6 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Presently available biological data are neither sufficiently accurate nor extensive enough to permit a definite estimate of genetic dose, but an estimate to indicate the order of magnitude and relative hazard of various radionuclides is possible. The dose to the gonads is estimated in 3 parts: γ emitters in the G.I. tract, γ emitters in the bladder, and the radionuclides in the gonads. The methods used are general, but only dose to the ovary is discussed. Considering the ovary a spherical mass and the bladder and gastrointestinal tract as spherical in shape, the dose from a sphere to a spherical shell is computed. It was found that the bladder usually does not make a significant contribution to the dose; but the G.I. tract does make a significant contribution, and in several cases it accounted for most of the dose. The importance of the G.I. tract lies in its size and the length of time radioactive material spends in passing through. (P.C.H.)

25073 STRONTIUM-90 IN MAN. J. Laurence Kulp (Columbia Univ., New York). p.1246-51 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

The status of the fall-out problem with particular reference to distribution in humans is summarized. It is concluded that about 75% of the Sr^{90} in the human diet is due to direct uptake by plants. Present concentrations of Sr^{90} in the world population are determined by analyzing large numbers of human bone samples from stations over the world. It was found that Sr^{90} concentration in bone for any population group on a reasonably uniform diet is a function of age. Future bone levels expected from nuclear detonations are estimated. Other isotopes present in small amounts are Sr^{89}, Pu^{239}, and C^{14}. The total radiation dose from these 3 isotopes is small. (P.C.H.)

25074 RADIATION DOSAGE FROM THOROTRAST. J. Rundo (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.1258-65 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

The radiation dosimetry of Thorotrast is discussed. The factors considered are the radiometric properties of the thorium series, the behavior of the thorium daughter-products following injection into the body, and following their formation within the body, and the self-absorption of alpha particles in the thorium-containing aggregates in liver, spleen, and bone marrow. The most reasonable estimates of the average radiation dose rates to these tissues are about 1.5, 2.5, and 0.3 rads per week from alpha particles, following injection of 75 ml Thorotrast. The dose rates to lung tissue are about 120 mrads per week, and 10 to 15 times higher to limited depths in the bronchus and trachea. The genetically significant dose to the population is negligible, although in individuals the dose to the gonads is approximately the same as the natural background. The dose to the skeleton needs further investigation; preliminary calculations indicate that it is about the same as, or more than that delivered by 0.1 μg of radium. (auth)

25075 AUTORADIOGRAPHIC DOSE DETERMINATION FOR THOROTRAST DEPOSITS AFTER RETROGRADE PYELOGRAPHY. C. E. Alken (Urologische Universitäts-klinik, Homburg/Saar, Ger.), J. C. Roucayrol, E. Oberhausen, A. Taupitz, and H. Ueberberg. p.1265-9 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

A dose determination made by analyzing α traces was carried out on two kidneys with high thorotrast deposits. The retrograde pyelography from which the thorotrast deposits originated was done in 1933 or 1934. The amount of radioactive decay products of Th^{232} remaining in the kidney was first determined, and the individual α emitters were identified. The distribution of the thorotrast particles was determined and tabulated. (J.S.R.)

25076 PHYSICAL QUANTITIES PROPOSED FOR RADIATION MEASUREMENTS. Lauriston S. Taylor. p.1301-2 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

The problem of physical quantities and units is outlined, and the function of the ICRU is discussed. (P.C.H.)

25077 RELATIONSHIP OF BIOLOGICAL DOSE TO PHYSICAL MEASUREMENT. L. H. Gray. p.1303-9 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

The necessity of having some measure of radiation, or its interactions, in physical terms for the purpose of evaluating biological effects is reviewed. The various factors and conflicts involved are discussed. Particular reference is made to the influence of dose rate on biological response. (P.C.H.)

25078 BASIC PROBLEMS OF DOSIMETRY. R. Glocker. p.1312-14 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

The basic problems of dosimetry are reviewed. The effects of the mass-volume, particle energy, and particle type on the dose determination are discussed. Ion density effects on radiation reactions are also considered. (J.S.R.)

25079 COMPARISON OF NATIONAL STANDARDS FOR ROENTGEN MEASUREMENT. H. O. Wyckoff. p.1315-18 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Two general methods are used for the comparison of national x-ray standards. The first involves a direct comparison of 2 standards in one laboratory. The second involves an interlaboratory instrument, either a scaled-down version of a national standard or a cavity chamber. One direct comparison of national x-ray standards (UK-USA) was made in

the last few years. Two comparisons (Sweden-USA and Sweden-Frankfurt) were reported in which a scaled-down model of the Swedish standard was calibrated against three national standards. One comparison (Paris-USA) involved the calibration of a modified cavity chamber and diaphragm with 2 national standards. Results are given of recent comparisons of x-ray standards. One comparison (Canada-USA) was completed with a Co^{60} source using the cavity chambers. Two sets of instruments are now available. (P.C.H.)

25080 STANDARD DOSIMETRY IN FRANCE. A. Allisy. p.1319-25 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

A survey is given of the work done on the preparation of French primary standards. The results of a comparison between French and American measurements are reported. In an appendix the Dosimetry Division of the Laboratoire Central des Industries Electriques is described. (tr-auth)

25081 OPEN QUESTIONS ON DOSIMETRY OF HIGH ENERGY GAMMA AND X-RAY BEAM THERAPY. Aldo Perussia. p.1325-8 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Due to the increasing range and anisotropy of secondary electrons, the methods and units of the conventional x-ray deep therapy dosimetry are no longer valid when high energy electromagnetic radiation is employed in beam therapy. The relative merits of the physical quantities and units which may be used in evaluating the radiation doses in tissues and the output of high energy γ and x-ray sources are discussed. At the present stage of evolution in measuring techniques, the adoption of an ionization unit could be a convenient remedy, provided such unit be so defined as to include also the functions of the old roentgen unit. Such a step should not, however, obstruct the trend toward a wider use of the absolute dose unit, i.e. of the rad. A useful action in this direction could be undertaken by encouraging the practice of expressing dosimetrical evaluations with reference to a physical model represented by a hypothetical phantom of suitable standard composition: a water or water-equivalent phantom would probably be the best choice both for isodose construction and output measurement. The evaluation of administered doses could thus be expressed in terms of water-rad at the point of interest, and the output measurements in terms of water-rad per unit time at the maximum of the build-up curve along the central axis of the beam. (auth)

25082 DOSIMETRY OF BETA-RAYS AND ELECTRONS. Robert Birkhoff (Oak Ridge National Lab., Tenn.). p.1328-38 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Design and calibration are described for a wrist-type dosimeter. The dosimeter is an improvement over pocket chambers, also discussed, not only in respect to its position on the wearer but also with respect to energy dependence. The device is sensitive to β radiation only on the sides and top (2π steradian). Field tests are currently being conducted. (P.C.H.)

25083 INTERNATIONAL COMPARISONS OF RADIOACTIVITY STANDARDS. W. E. Perry and W. B. Mann. p.1338-42 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

A study by the ICRU Committee I is presented. The paper consists mainly of tables of internation comparisons of standards, the participating laboratories, methods of measurements used, and measurements on Hönigschmid standards. (P.C.H.)

25084 MEASUREMENT OF ABSORBED DOSE AS DISTRIBUTED IN LET AND OTHER PARAMETERS. Harald H. Rossi. p.1343-8 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

The device employed is a proportional counter with a shell of tissue-equivalent plastic filled with tissue-equivalent gas at low pressure. A corrective grid assures uniform gas multiplication of any ions produced as a result of the passage of a charged particle. Individual pulses are amplified by a high gain linear amplifier and sorted by a multichannel differential analyzer. Essentially the device registers the pattern of events which would occur in a spherical volume of tissue with a mass equal to the mass inside the proportional counter. Pressure in the counter is 10 mm. Because of its large geometrical cross section the counter registers simultaneously the events taking place in a number of unit density spheres. The number is of the order of 10^{10}. (P.C.H.)

25085 THE CALORIMETRIC DETERMINATION OF LOCAL ABSORBED DOSE. P. Milvy, N. Barr, J. Geisselsoder, and J. S. Laughlin. p.1348-60 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

A calorimetric method that directly measures absorbed dose in tissue-like plastic material is described and compared with the energy absorbed in an $FeSO_4$ solution under identical conditions. The design and construction of the calorimeter is described also. Standard deviation of the apparatus is about 1% when irradiated at a dose rate of 50 rads/min or more. Measurements are given of the absorbed dose rate from Co^{60} gamma rays at a particular point in conducting plastic. A Fricke $FeSO_4$ dosimeter solution was identically irradiated. With a G value of 15.45 molecules/100 ev, the $FeSO_4$ data indicated an absorbed dose rate in the calorimeter absorber 3 to 4% greater than that detected thermally. A similar difference is expected to result from endothermic reactions. The construction of a carbon calorimeter, "carbon extrapolation" chamber, and carbon jig for containing the Fricke $FeSO_4$ dosimeter is also described. (P.C.H.)

25086 MIXED RADIATION DOSIMETRY AND ITS APPLICATION IN DETERMINING THE DOSE RECEIVED BY THE JAPANESE AT HIROSHIMA AND NAGASAKI. G. S. Hurst (Oak Ridge National Lab., Tenn.). p.1361-74 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

Discussion is restricted to tissue, although some of the techniques described are applicable to a number of materials. The main concern is with the determination of energy absorbed per gram of tissue as a result of interactions with neutrons and γ rays. The techniques described are: (1) the proportional counter methods for determining tissue dose due to fast neutrons, (2) the threshold detector method of determining the neutron spectrum, (3) the single ionization detector for measuring the gamma dose in the presence of neutrons, and (4) the application of mixed radiation dosimetry with proportional counters and threshold counters. (P.C.H.)

25087 PHYSICAL BASIS FOR DOSIMETRY OF β RAYS. K. K. Aglintzev and V. P. Kassatkin. p.1375-80 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

For determination of the mean β dose, the number of β particles and their energy distribution must be known. The effective electron spectra of S^{35}, W^{185}, Tl^{204}, Y^{91}, $Sr^{90} + Y^{90}$, P^{32}, and $Ce^{144} + Pr^{144}$ at various depths of a tissue-equivalent substance were measured and graphed. The contribution to the dose of electrons of various energies in the field of S^{35}, Tl^{204}, and Y^{91} sources was determined. The dose dependence of a β particle on the maximum energy of the β spectrum was measured. The results permit the determination of dose magnitudes at various depths of the substance irradiated with a fixed number of β particles of a given isotope. (J.S.R.)

25088 PROGRESS IN CHEMICAL DOSIMETRY. W. Minder (Universität, Bern). p.1381-8 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In English)

The three main dosimetric methods are the Fricke dosimeter, reduction of ceric ions in acid aqueous solutions, and acid formation from aqueous solutions of halogenated hydrocarbons. The sensitivities, dose ranges, and dose rate independence of these methods are considered. (P.C.H.)

25089 DOSIMETRY OF IONIZING AND NEUTRON RADIATION BY THERMOLUMINESCENCE. N. Häring and M. Schön. p.1388-91 of "IXth International Congress of Radiology. Vol. 2." B. Rajewsky, ed. Stuttgart, Georg Thieme Verlag, 1961. (In German)

The properties which a thermoluminescent crystal must have to be usable as a radiation detector are discussed. The utilization of a Mn-activated CaF_2 crystal for this purpose was tested. A crystal with 3 mole % Mn appeared to offer the best possibilities. The design of an apparatus for the measurement of the thermoluminescence is described. (J.S.R.)

25090 NUCLEAR SAFETY. Technical Progress Review, Vol. 2, No. 4. W. B. Cottrell, ed. (Oak Ridge National Lab., Tenn.). June 1961. 76p. Dep.(mc); $0.55 (GPO) (Domestic), $0.70(GPO) (Foreign)

The analysis and control of hazards associated with nuclear reactors, operations involving fissionable materials, and the products of nuclear fission are discussed. Topics covered include reactor siting trends and development, safety in nuclear ship propulsion, graphite oxidation, application of statistical analysis to the hot-spot problem, redundancy and coincidence in reactor safety systems, control rods and control-rod drives in power reactors, removal of contaminants from gas streams, analytical radiochemistry and nuclear incidents, hazards associated with waste treatment, use of routine meteorological observations for estimating atmospheric dispersion, redox multipurpose dissolver incident, accidents in nuclear energy operations, changes in licensing regulations, legislation and organization, action on reactor projects by licensing and regulating bodies, and safeguards reports. (M.C.G.)

25091 RADIOLOGICAL HEALTH DATA MONTHLY REPORT, JUNE 1961. VOLUME II, NUMBER 6. (Public Health Service, Washington, D. C.). 36p. $0.50(GPO).

Data are tabulated on the radioactivity in samples of air, milk, food other than milk, and water collected in the U. S. during 1960 and 1961. Results are included from a survey on environmental levels of radioactivity at AEC installations. Data are tabulated from assays conducted in Japan for Sr^{90} in human bone and Cs^{137} in various human tissues. (C.H.)

25092 RADIOLOGICAL HEALTH DATA QUARTERLY REPORT, JULY 1961. VOLUME II, NUMBER 7. (Public Health Service, Washington, D. C.). 64p. $0.50(GPO).

Data are tabulated on the radioactivity in samples of air, milk, food other than milk, and water collected in the U. S. during 1960 and 1961. Results are included from whole-body measurements of Cs^{137} in people at Washington, D. C., and Landstuhl, Germany. Data are summarized from a medical survey of Marshallese people, five and six years after exposure to fall-out from a thermonuclear explosion. Whole-body measurements of the internal contamination provide information on the movement of Cs^{137}, Zn^{65}, and Sr^{90} from the environment to man, on the rate of equilibration of these isotopes with the environment, and on the discrimination factors between food and man. Data are included from a nation-wide survey of hospitals and radiologists to assess the use of x rays, principally for diagnostic purposes in U. S. Hospitals. Results are included from a survey on environmental levels of radioactivity at AEC installations. (C.H.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

25093 (ARF-1150-12) DESIGN STUDIES ON CESIUM-137 AS A SOURCE FOR HIGH LEVEL GAMMA IRRADIATORS. Final Report, June 1, 1959 to July 31, 1960. L. Voyvoidic (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Dec. 5, 1960. Contract AT(11-1)-779. 50p.

Analytical and experimental studies were made of the influence of design factors on the efficiency, depth dose uniformity, and dose rate of high level, plaque cesium-137 irradiators. Approximate theoretical expressions were derived for irradiators with plaque sources and slab absorbers where the attainment of high efficiencies, together with satisfactory dose rate and dose uniformity are particularly stringent requirements. The irradiator performance relationships are expressed in terms of a geometry factor, G′, which governs the spatial dose rate distribution within the absorber. The form of G′ found particularly informative and useful for analytical design studies is based on multiple scattering calculations; $G'(b) = K_0 E_1(b) + K_s \beta e^{-b}$ where the term $E_1(b)$ is caused by the uncollided photon flux from an equivalent infinite plane source, βe^{-b} is from the presence of scattered radiation, and the factors K_0 and K_s represent the total corrections required for finite source lateral dimensions, non-homogeneity in atomic composition, presence of air gaps, etc. For sources with very large lateral dimensions, where $K_0 \sim K_s \sim 1$, and six-inch water absorbers, the calculated values of the geometry factor G′ appear to be nearly independent of gamma energy. Also, the depth dose variation quickly becomes exponential from the dominant effect of the scattered radiation. The scattered photons are expected from theory to be strongly peaked in the region of 60 Kev in a water absorber, again nearly independent of the initial source photon energies. For a single plaque source irradiating alternate faces of a slab absorber of thickness t, the effective dose rate, at half-depth in the absorber, becomes: $\overline{D} = 2 \pi k_a h S_m \overline{G}'$. The efficiency of the irradiator, based on the energy absorption at half-depth, is: $F = (\mu_a^{ot})(H_t/H_s)(L_t/L_s)\overline{G}'$. The depth dose rate uniformity is expressed as: $U = (G'_f + G'_b)/2\overline{G}'$, where $\overline{G}' = G'(t/2)$ is the geometry factor at half-depth, h, H_s, L_s are the source thickness, height and length, H_t, L_t are the effective target height and length over which the effective dose rate has the value $\overline{D}$, S_m is the source material specific activity, and G'_f, G'_b are the geometry factors at the front and back surfaces of the slab absorber. Experiments carried out with low-level cesium-137 plaque sources, with water and paraffin slab absorbers, were designed to test the theoretical predictions. Using scintillation dose-rate meters and photon spectrometers, the observations shown on the absolute dose rates, the dose-rate distribution, and G′ factor, as well as the spectral distribution of gamma radiation within the absorbers, were all found to be in satisfactory agreement with the predicted performance. The economic attractiveness of cesium-137 as source material for high level irradiators is found to be particularly sensitive to the over-all efficiency of the irradiator. Based on plausible estimates for capital charges and radiation cell costs, plus a high duty cycle, it appears that cesium-137 could provide irradiation costs as low as $1 per kilowatt-hour of absorbed energy, or 0.12 cents/megarad pound, if it were available at about 10 cents/curie and used in large irradiators at about 67% useful conversion efficiency. (auth)

25094 (BMI-X-171) RADIOISOTOPE AND RADIATION APPLICATIONS. Quarterly Progress Report. Duane N. Sunderman, ed. (Battelle Memorial Inst., Columbus, Ohio). Oct. 31, 1960. Contract W-7405-eng-92. 18p.

A series of experiments was completed using the process model for studying radiotracer control of iron removal from a nickel-refinery stream. The results of 13 experimental runs indicated that the radiotracer control concept is technically sound. The iron reduction ratios obtained by radioassay agreed well with the iron reduction ratios given by chemical analysis. The radioactivity monitor on the filtrate stream provided a rapid and sensitive indication of changes in process operating conditions. The survey of chemical engineering unit operations as potential intrinsic radiotracer applications was completed. The study of the mechanism of formation of free radicals in polymethacrylates was continued. Particular emphasis was placed on an examination of the effect of structural factors on the efficiency of free-radical site formation. The investigation of the influence of free-radical formation of the hydrocarbon constituent of the ester side chain was continued. In addition, polymer molecular weight was found to influence site concentration. (auth)

25095 (BMI-X-172) RADIOISOTOPE AND RADIATION APPLICATIONS. Quarterly Progress Report. Duane N. Sunderman, ed. (Battelle Memorial Inst., Columbus, Ohio). Jan. 18, 1961. Contract W-7405-eng-92. 18p.

An evaluation was given of the possible hazards to consumers from radioisotope residues in consumer products. A laboratory demonstration was given of the use of Mn^{54} to facilitate removal of manganese from process feed water. It was found in the hazards evaluation that the "worst case" of radiation exposure from residual radioisotopes in steel gives a radiation exposure somewhat less than the maximum allowable dose levels for occupational exposure. Initial study indicates that for actual cases, the radiation exposures to be expected from radioisotope residues in steel products would ordinarily be small compared to natural background. An exception to this generalization might be found when a longer lived isotope like Mn^{54} was present. Preliminary results of the laboratory demonstration of using Mn^{54} to monitor the removal of manganese from feed water indicated that the method may allow a considerable improvement in accuracy of process control. The study of the mechanism of formation of free radicals in polymeric materials was continued. Emphasis was placed on examination of the effect of structural factors on the efficiency of free-radical site formation in acrylate polymers. The investigation was extended to include an examination of the effect on free-radical formation of the constituents on the carbon atom located alpha to the ester group. Polymethylacrylate, polymethylmethacrylate, and polymethyl-α-chloroacrylate were used in this study. Measurement of the volatile products from the irradiation of the polymethyl-α-chloroacrylate was completed. The data substantiated earlier findings which indicated that the

point of attack in free-radical formation occurs on the ester side chain. (auth)

25096 (BMI-X-173) RADIOISOTOPE AND RADIATION APPLICATIONS. Quarterly Progress Report. Duane N. Sunderman, ed. (Battelle Memorial Inst., Columbus, Ohio). May 2, 1961. Contract W-7405-eng-91. 38p.

Results of the final dynamic experiments with the iron-removal process model using Fe^{59} indicated that the intrinsic-radiotracer method is rapid, accurate, and suitable for continuous readout. Results from both static and dynamic experiments on the use of Mn^{54} to aid in removing manganese from process water indicated that intrinsic radiotracers can be used to help remove low-concentration critical impurities. One phase of the hazards evaluation was concerned with the ingestion of radiotracer residues which might arise from corrosion of radiotracer-containing steel products. It was concluded that no hazard exists from this source. Another part of the hazards study was concerned with the technical hazards to sensitive industries which might use steel containing radiotracer residues. This area is the most sensitive one encountered in the study. The study of the mechanism of formation of free radicals in polymeric materials was continued. Emphasis was placed on examination of the effect of structural factors on the efficiency of free-radical site formation, especially in acrylate polymers. An initial investigation of the effect of polymer tacticity was completed using polypropylene. The influence of molecular mobility on site formation in polymethylacrylate was established. Measurements of the volatile products from irradiation of the polymers was completed. The concentration of free-radical sites determined for each of these polymers from the volatile-product data agreed reasonably well with that found by means of electron paramagnetic resonance. Preliminary studies were initiated to develop safety performance criteria for sealed sources and to determine the applicability of standard test procedures employed in other industries. (auth)

25097 (NP-9585) LONG-TERM DOG-FEEDING OF IRRADIATED AND CONTROL FOODS AND ITS EFFECT UPON THE BLOOD SERUM CONSTITUENTS (Phase 1), AND NUTRITIVE VALUE OF IRRADIATED PROTEINS AND CONTROL PROTEINS (Phase 2). Report No. 7 [for] Period Six months ending September 15, 1960. D. F. Watson, R. M. Smibert and R. W. Engel (Virginia. Agricultural Experiment Station, Blacksburg). Contract DA-49-007-MD-784. 9p.

I. Puppies, 69 days old, and aged dogs, 3 years and 5 months and 1 year and 5 months old, were fed irradiated rations of solid foods at the level of 25 g per day per pound of body weight and 600 g per day, respectively. Hematological, serum protein, and blood chemistry data are tabulated. Future plans are also included. II. An investigation was made of the characteristics of chymotrypsin treated with ethylene oxide. Results indicate that ethylene oxide does not react with the histidine of chymotrypsin. The reaction is limited to three other amino acids. With prolonged exposure, lysine reacts with ethylene oxide, but the reaction of methionine with ethylene oxide is not yet established. (P.C.H.)

25098 (NYO-2506) THE TECHNOLOGY AND APPLICATIONS OF LARGE FISSION PRODUCT BETA SOURCES. Quarterly Report, April 1—June 30, 1961. (Radiation Applications Inc., Long Island City, N. Y.). July 13, 1961. Contract AT(30-1)-2186. 7p.

Initial leach test results on enamels prepared with $Ce^{144}Cl_3$ indicated extremely low rates of water leaching at room temperature. However, the rate of Ce^{144} removal from the enamel in boiling water was appreciable. Experiments with solvents, acid, and alkali as the leaching media are in progress. A non-active cerium enamel was prepared using a furnace capable of higher operating temperatures than those previously obtained. The resulting glass was higher melting than recent preparations and was completely free from undissolved materials. This batch of enamel was used to prepare slides for thermal and mechanical shock tests. The radiation dose rate emitted from cerium-containing beta source slides is being evaluated by means of photographic film dosimetry. Results to date were obtained in terms of total dose rate which includes natural beta and gamma emission plus bremsstrahlung due to interaction of beta particles with the enamel and stainless steel backing. A number of modifications were made in the hot cell facility in order to maintain safety and ease of operation. The cell is now ready for continued preparation of active enamels. (auth)

25099 (TID-3565) RADIOSTERILIZATION OF EDIBLE FISH, MOLLUSKS AND CRUSTACEANS. A Literature Search. Theodore F. Davis, comp. (Office of Technical Information Extension, AEC). Aug. 1961. 14p.

Included are 69 references to U. S. and foreign reports and published literature published from 1950 to 1961. For convenience in abstract scanning, NSA abstract numbers are given when possible. (P.C.H.)

25100 (NP-tr-689) CHANGES IN STARCH AND ITS DECOMPOSITION PRODUCTS AFTER TREATMENT OF WHEAT FLOUR WITH GAMMA RAYS. A. R. Deschreider. Translated by D. Hanley for U.K.A.E.A. Atomic Energy Research Establishment from Stärke, 12: 197-201(1960). 15p.

Changes in flour starch as a result of irradiation with γ rays are described. Twelve samples from various origins were exposed to doses of 25 to 2000 kilorads. The extent of change was found to be conditioned by the type of flour. Possible reaction mechanisms involved in radioinduced depolymerization of starch in irradiated flour are discussed. Data are tabulated on the formation of maltose in irradiated flour, the viscosity of a 2% starch solution from irradiated flours, and the solubility of amylopectin in starch from irradiated flour. (C.H.)

25101 (NP-tr-692) IONIZING RADIATION FOR THE PRESERVATION OF FOODSTUFFS. A. N. Liberman. Translated by J. M. Crabtree for U.K.A.E.A., Atomic Energy Research Establishment from Voprosy Pitaniya, 16: No. 6, 52-6(1957). 9p.

Results are summarized from a number of studies on the use of ionizing radiation in food processing. Experiments on the irradiation of food using x radiation, cathode rays, γ rays show that there is an identical sterilization effect for unit energy of the different ionizing radiations. The radiation dose required to sterilize a given foodstuff depends on the type and number of microorganisms in it, the nature of the product, and the conditions of irradiation. One difference between radiation and thermal sterilization is that there is a time interval between exposure of the foodstuffs to doses absolutely lethal for microorganisms and their destruction, during which metabolic processes continue in the microorganisms. Exposure to large radiation doses causes undesirable chemical changes in the products which may be manifest by softening, color changes, and foreign odors and tastes. The nature and degree of these changes depend on the properties of the product itself as well as on the exposure dose. No evidence was found of toxic properties induced by radiosterilization. Procedures are outlined for

reducing the undesirable organoleptic and physiochemical changes occurring when foodstuffs are exposed to ionizing radiation. (C.H.)

25102 RADIATION USES IN INDUSTRY AND SCIENCE. Lloyd E. Brownell (Michigan. Univ., Ann Arbor). 432p.

A survey is presented of some of the nonpower and nonmedical uses of atomic energy that have been proven practical and of other possible applications. The survey, written for industrial management, deals with properties of ionizing radiations, reactors as radiation sources, radiation uses, tracer studies and autoradiography, radiation chemistry, biological radiation effects and their applications, and radiation measurement. Extensive bibliographies are included. (D.L.C.)

ISOTOPE SEPARATION

25103 (GAT-T-947) DISTILLATION AS A MEANS OF REDUCING THE OIL CONCENTRATION IN CASCADE COOLANT. N. W. Houston (Goodyear Atomic Corp., Portsmouth, Ohio). June 26, 1961. 9p. Contract AT-(33-2)-1.

Samples removed from the cascade coolant systems showed that these systems contain hydrocarbon contamination in concentrations ranging from 10 to 88 ppm. In addition, oily residues in gas coolers were analyzed as primarily petroleum oil mixed with a solid residue. Laboratory studies indicate that the contaminant is probably lubricating oil. It is believed that the oil not only adversely affects gas cooler efficiencies, but may also render the coolant reactive to UF_6. Studies were initiated to determine the possibility of using a distillation process for the removal of oil from the coolant. The studies showed that the oil content could be reduced to 5 ppm. or less by a simple distillation process. The distillation process could be used, if necessary, to purify the coolant used in the cascade coolant systems. (auth)

25104 (NP-9593) SOME ASPECTS OF THERMAL DIFFUSION AT LOW CONCENTRATIONS (Thesis). Dieter Heymann (Amsterdam. Universiteit). 1958. 96p.

A two-bulb apparatus was constructed and the thermal diffusion factors of the systems $Xe-H_2$, $Xe-D_2$, Xe−He, Xe−Ne, $Xe-N_2$, and Xe−Ar were measured in the range of 300−700°K. The experimental results were fitted to the expected theoretical dependence of separation on temperature, and the thermal diffusion factors of the systems were calculated at different temperatures. The results were interpreted as a confirmation of the opinion that the R_T-value of non-isotopic mixtures has only relative importance. The investigation of the extraction of Xe from D_2 was undertaken with a hot-wire column, the performance of which was studied at different temperatures and pressures. Results are given. (P.C.H.)

25105 (NYO-8770) SEPARATION AND EXCHANGE OF ISOTOPES. Annual Progress Report, July 1, 1960 to June 15, 1961. William Spindel, Lois Nash Kauder, E. U. Monse, Marvin J. Stern, Paul R. Gross, and Robert Greenberger (Rutgers Univ., Newark, N. J.). June 15, 1961. Contract AT(30-1)-2250. 208p.

Work on exchange reactions involving isotopes of nitrogen, carbon and oxygen, as well as some studies on deuterium isotope effects on biological processes are described. Studies of the single stage separation factor for N^{15} exchange in the nitric oxide−nitrate system were completed. The effective separation factor was measured for exchange of nitric oxide with nitrate salt solutions, and nitric acid solutions ranging in concentration from 1 to 12 molar, over a temperature range of 25 to 75°C. The effective exchange factor was compared with the individual exchange equilibrium constants in the system; the correlations are reasonably satisfactory in view of the uncertainties of individual exchange constants and chemical composition. Studies of oxygen isotope fractionation were continued. The effect of azeotropism on the separation of O^{18} by distillation of a maximum boiling, aqueous ethylenediammine solution was noted. A negative effect on the isotopic fractionation in pure water was obtained. Isotope exchange between a 16 molal lithium chloride solution and water vapor was studied in a packed column. The separation factor for this solution at 145°C was comparable to that observed for water at 100°C. Studies of C^{13} and O^{18} fractionation by exchange between CO and $Ni(CO)_4$ in a packed exchange column, over the temperature range from −10 to +18°C, permitted an estimate of the rate of this exchange. The half time varied from ~0.2 min at 18°C to ~4 min at −10°C. Experiments on deuterium isotope effects on eggs of the sea urchin, Arbacia Punctulatus are reported. Cells maintained in D_2O did not incorporate tritiated thymidine as did cells in a normal isotopic medium. This weakened a previous supposition that synthetic activity continues while cells are immersed in D_2O. Further, it was observed that unfertilized eggs stored in D_2O do not divide normally when returned to a light water medium and fertilized. (auth)

25106 (TID-12855) SEPARATION OF GASES BY THERMAL DIFFUSION USING BOUNDARY LAYER SUCTION. Final Report. Norman T. Mills and Robert L. Pigford (Delaware. Univ., Newark). June 1961. Contract AT(30-1)-1736. 98p.

Studies were made on a proposal that improvement in operation of thermal diffusion equipment might result if the thermal and hydrodynamic behavior could be controlled independently. The procedure employed was to pass a gaseous mixture past a heated, flat, porous plate to which suction was being applied. In this manner the gas near the plate, rich in one component because of thermal diffusion, was continuously removed. Since boundary layers exhibit steep temperature gradients it was expected that measurable separations would be achieved with a surface of minimum size. This was found to be the case. Separations greater than one per cent enrichment in the lighter component were observed. The gaseous system used for the investigation was helium and nitrogen. The variables that were found to be most important with respect to affecting the separation were the tangential velocity, the suction velocity, the plate temperature, the length of the plate undergoing suction, and turbulence in the boundary layer. It was found that the separations were greater for increased plate temperature, decreased tangential velocity, decreased suction velocity, and decreased plate length. Induced turbulence was found to have little or no effect on the separations. The data showed that the separations achieved did not conform to the mathematical analysis that was made on the assumption of an idealized, rod-like velocity distribution. In some runs the observed separations were nearly twice as great as expected and were almost as large as would have been obtained at stationary conditions in a fluid mixture held motionless between adjacent hot and cold surfaces. It was concluded that the mathematical theory presented did not adequately represent the physical circumstances. It was further concluded that energy efficiencies for the process may be greater than predicted from theory and that the process might be attractive when energy usage is critical. (auth)

25107 (AEC-tr-4394) ISOTOPE SEPARATION. W. Walcher. Translated for Oak Ridge Gaseous Diffusion Plant from Ergeb. exakt. Naturw., 18: 155-6; 175-91; 206-13; 219-23(1939). 60p. (Includes original, 6p.).

Selected parts of a review of isotope separation methods were translated. These parts include those dealing with diffusion, thermal diffusion, centrifuge, and a comparative evaluation of methods. (D.L.C.)

25108 (AEC-tr-4395) ADDITIONAL EXPERIMENTS FOR THE SEPARATION OF ISOTOPES PRODUCTION OF PURE HEAVY HYDROGEN BY DIFFUSION. H. Harmsen, G. Hertz, and W. Schütze. Translated for Oak Ridge Gaseous Diffusion Plant from Z. Physik, 90: 703-11(1934). 15p.

A 24-stage apparatus utilizing clay pipes for the separation of gaseous isotope mixtures was enlarged to 48 stages and modified for maximum transport velocity. Pure Ne^{22} could be prepared from ordinary Ne in a single application in the apparatus. D_2 could also be prepared with a high purity; starting with H_2 containing ~1% D%, ~1 cc spectroscopically pure D_2 results within 8 hr at atmospheric pressure. (D.L.C.)

25109 (AEC-tr-4486) THE FIRST SEPARATION OF CHLORINE ISOTOPES. William D. Harkins and Clarence E. Broeker. Translated from Z. Physik, 50: 537-47(1928). 26p. (R-529-N)

Details of the method used in the first separation of chlorine isotopes, carried out in December 1919 are presented. The method consists essentially in comparing the densities of equimolar solutions of normal and isotopic hydrogen chloride. (J.R.D.)

25110 (AEC-tr-4745) SLIP PHENOMENA DURING GASEOUS DIFFUSION. E. Wicke and P. Hugo (Munster, Germany. Universität. Institut fur Physikalische Chemie). Translated for Oak Ridge National Lab. 60p. (Includes original, 36p.).

The influence of diffusion slip on the material transport for the countercurrent diffusion of two gases through porous fritted glass disks was measured and interpreted theoretically in relation to the known methods for the calculation of slip phenomena. The calculations performed by Kramers and Kistenmaker were generalized to arbitrary diffusion countercurrent conditions with consideration of the frictional slip. Corresponding diffusion measurements with a superimposed convection through porous walls confirmed the relationships derived. Equations were developed to calculate the characteristic pressure losses at the single fritted plates of the double cell for a series of gas pairs. The results are compared with corresponding test values. (M.C.G.)

25111 (AEC-tr-4751) METHOD FOR THE SEPARATION OF GASES AND MIXTURES OF ISOTOPES. Inventors: Jens Christiansen and Karl-Friedrich Leisinger. Translated for Oak Ridge Gaseous Diffusion Plant from German Patent No. 1,055,508, Apr. 23, 1959. 4p.

A method for the separation of gases and mixtures of isotopes by pressure reduction of the mixture through a nozzle into an evacuated vessel is described. The method is characterized by the fact that the greater part of the vessel wall is held at a temperature which is so low that most of the molecules from the inflowing gas striking the wall are precipitated. Several cooling baffles concentrically arranged around the beam are utilized. (M.C.G.)

25112 (AEC-tr-4753) CONCENTRATION OF URANIUM^{235}: REVIEW OF SOME OF THE MOST IMPORTANT METHODS AND PRINCIPLES. F. I. Havlicek. Translated for Oak Ridge Gaseous Diffusion Plant from Energia nucleare (Milan), 6: 521-31(1959). 38p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 20000.

25113 (AEC-tr-4754) METHOD FOR THE SEPARATION OF GASES, VAPORS OR MIXTURES OF GASES AND VAPORS, PARTICULARLY OF ISOTOPES. Translated for Oak Ridge Gaseous Diffusion Plant from German Patent No. 1,060,846, July 9, 1959. 7p.

Equipment for the separation of gases, particularly for the separation of isotopes, in which separation takes place by skimming of a gas beam emanating from a nozzle-type opening by a diaphram located opposite the nozzle and by a separate removal of the partial beam formed is described. The equipment consists of a pressure-tight vessel with a minimum of 3 gas collecting chambers characterized by an arrangement of a number of relatively narrow chambers formed by walls in a lamellar arrangement and equipped with slit-shaped or round openings. The walls are interconnected by means of these openings which terminate in one of the gas collecting chambers in such a manner that each similar chamber is connected to another. (M.C.G.)

25114 (AEC-tr-4766) DIFFUSION IN THE GAS CENTRIFUGE. Janez Strnad. Translated for Oak Ridge Gaseous Diffusion Plant from Glasnik mat. fiz. i Astron., Ser. II, 14: 295-302(1959). 11p.

For the case of diffusion in the gas centrifuge, the diffusion equation was solved approximately for rigid rotation of the gas. It is shown that diffusion decreases with the circumferential speed of the centrifuge. Diffusion during starting and braking of the centrifuge is considered, and the application of the results to the countercurrent centrifuge is discussed. (D.L.C.)

25115 SEPARATION OF SILICON ISOTOPES BY MONOSILANE RECTIFICATION. G. G. Devyatykh, G. K. Borisov, and A. M. Pavlov (Gorkii State Univ., USSR). Doklady Akad. Nauk S.S.S.R., 138: 402-4(May 11, 1961). (In Russian)

Fractional distillation of the monosilane was carried out in a packed column 240 cm high and 10 mm in diameter. The distillation was conducted at a monosilane pressure of 560 mm Hg which corresponded to a temperature of –117°C. Monosilane samples were burned in oxygen to SiO_2 which was dissolved in HF. Then $BaCl_2$ was added in order to precipitate barium silicofluoride which gave SiF_4 on thermal decomposition. The SiF_4 sample was run in a MI-1305 mass spectrometer to determine the concentration of $Si^{28}F_3^+$, $Si^{29}F_3^+$, and $Si^{30}F_3^+$ in the sample. Separation factors for Si^{29} and Si^{30} were determined as the ratio of the isotopic ratios in samples taken from the distillation vessel and the fractionating column at the same time. Steady-state conditions were attained in the column. Separation coefficients equal to the relative vapor pressure of the various monosilane isotopes were calculated from the data. It was found that $\alpha_{29} = P(Si^{28}H_4)/P(Si^{29}H_4)$ was 1.00035 ± 0.00007, and that $\alpha_{30} = P(Si^{28}H_4)/P(Si^{30}H_4)$ was 1.00061 ± 0.00010. (TTT)

25116 CENTRIFUGAL SEPARATORS. (to United Kingdom Atomic Energy Authority). British Patent 873,772. July 26, 1961.

A gas centrifuge of the continuous, flow-through type is designed with means for controlling temperature gradients in the gas and utilizing it to enhance the separation of gaseous mixtures. (D.L.C.)

MATHEMATICS AND COMPUTERS

25117 (AFOSR-746) QUANTUM STATISTICS AND THE BOLTZMANN EQUATION. Research Report. Robert M. Lewis (New York Univ., New York. Inst. of Mathematical Sciences). June 1961. 61p. (HT-8)

The system of hierarchy equations for the reduced density operators of quantum statistical mechanics is replaced by a single functional differential equation for a generating functional. A formal solution of the initial value problem for the latter equation is obtained, leading to series expansions of the reduced density operators. The expansions are used to obtain an improved derivation of the quantum-mechanical Boltzmann equation. (auth)

25118 (ATL-A-105) DMM: A MULTIGROUP, MULTIREGION, ONE-SPACE-DIMENSIONAL COMPUTER PROGRAM USING NEUTRON DIFFUSION THEORY. PART I. THE THEORY. Final Report. Edward J. Leshan and Devereux L. Kavanagh (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). Dec. 31, 1960. Contract AF33(616)-6097. 48p.

DMM is a program using one-space-dimensional multigroup diffusion theory to calculate the reactivity or critical conditions and flux distribution of a multiregion reactor. Calculations of fission-produced xenon and samarium and time variation due to production and depletion of isotopes are an essential part of this program. The adjoint fluxes may also be computed, and the program includes the calculation of the nuclear constants from fairly simple input combined with a library of cross sections. The present code is written for the Remington Rand 1103A. Operating instructions are presented in Part II. (auth)

25119 (ATL-A-111) DMM: A MULTIGROUP, MULTIREGION ONE-SPACE-DIMENSIONAL COMPUTER PROGRAM USING NEUTRON DIFFUSION THEORY. PART II. DMM PROGRAM DESCRIPTION. Devereux L. Kavanagh, Martin J. Antchagno, and Elaine K. Egawa (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). Dec. 31, 1960. Contract AF33(616)-6097. 601p.

Operating instructions are presented for DMM, a Remington Rand 1103A program using one-space-dimensional multigroup diffusion theory to calculate the reactivity or critical conditions and flux distribution of a multiregion reactor. Complete descriptions of the routines and problem input and output specifications are also included. (D.L.C.)

25120 (CF-61-5-54) IBM 7090 GAUSSIAN INTEGRATION ROUTINES. M. B. Emmett and S. K. Penny (Oak Ridge National Lab., Tenn.). May 16, 1961. 8p.

Discussions are given for three IBM 7090 Gaussian integration routines, GINT1, GINT2, and GINT3, which are written in FAP for use with FORTRAN programs and subroutines. (B.O.G.)

25121 (CNI-61) A CODE FOR THE REACTIVITY CHANGES DUE TO CONTROL ROD INSERTION IN A REACTOR. C. Tamagnini (Italy. Comitato Nazionale per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). Oct. 1960. 18p.

A code evaluating by means of two group theory the reactivity changes due to a ring of control rods in a bare reactor was prepared for an IBM-650 computer. A method taking into account partial insertion of control rods into the core and in the top reflector of a reflected reactor is also described. (auth)

25122 (ORNL-3148) STRUCTURE AND USE OF ALGOL 60. Hermann Bottenbruch (Oak Ridge National Lab., Tenn.). July 26, 1961. Contract W-7405-eng-26. 52p.

ALGOL 60 is a universal, algebraic, machine-independent programming language. It was designed by a group representing computer societies from many different countries. Its primary aims are: (1) simplification of program preparation, (2) simplification of program exchange, and (3) incorporation of the important programming techniques presently known. An elaboration of the concepts of ALGOL 60 is given, mostly with the help of illustrative examples. (auth)

25123 (TID-13315) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. MATHEMATICAL METHODS. PART IV. DATA REDUCTION METHODS. PART V. ILLIAC USE AND OPERATION. PART VI. IBM 650 USE AND OPERATION. PART VII. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Mar. 1961. Contract AT(11-1)-415. 55p.

Activities are discussed for developments in the high-speed computer program and the circuit program. The derivation of mathematical methods include an approximate stress energy tensor for gravitational fields, and Monte Carlo methods in quantum statistics. The continuation of studies of methods for the automatic reduction of data from bubble chamber photographs is described. Outlines are given of the use and operation of the IBM 650 and the Illiac. A description is presented of a routine for the IBM 650 for the analysis of variance of Latin Square design experiments with a single degree of freedom. (B.O.G.)

25124 (NP-tr-659) ELECTRONIC COMPUTERS AND THEIR APPLICATIONS. (Elektronnye Vychislitel'nye Mashiny i ikh Primenenie). F. V. Mayorov. Translated from a publication of the Military Publishing House of the USSR National Defense, Moscow, 1959. 466p.

The operating principles of the electronic computers are discussed. Special attention is devoted to the components of digital computers based on electron tubes, semiconductor diodes and triodes, and ferrite cores. Examples are given of the utilization of the computers which indicates that the machines are a powerful means to scientific and technological progress and is not confined solely to the field of strictly mathematical computations. (B.O.G.)

25125 DIGITAL BINARY-DECIMAL DECODER FOR A HUTCHINSON-SCARROTT-TYPE ANALYSER. Velimir N. Kostić and Miodrag N. Momčilović. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 105-9(Mar. 1961). (In English)

A digital binary-decimal decoder for decoding the binary content of the dynamic memory of the Hutchinson-Scarrott-type analyser is described. The decoder is based on the transmission of the complementary binary content of the selected analyser memory channel to the auxiliary dynamic memory of the decoder and serial addition of pulses to the complementary content of the auxiliary memory until the number of stored pulses in the channel observed has been obtained. The rate of decoding is 20000 pulses per second. The decoded channel content is indicated on a decimal scaler. The memory content of the analyser is not destroyed by decoding. (auth)

25126 SOLUTION OF INTEGRAL EQUATIONS ON A DIFFERENTIAL ANALYSER BY FREDHOLM'S METHOD. Nediljko S. Parezanović. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 111-22(Mar. 1961). (In English)

It is shown how the solution of integral equations can be obtained on a differential analyser by Fredholm's method, i.e., by transformation to the system of linear algebraic equations. The solution of the system of linear equations is performed by Gauss-Seidel's method. The unknown function is obtained in the form of step approximation. The paper shows how the step approximation can be improved according to the form of the unknown function. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

25127 (60-RL-2572M) PREPARATION AND PROPERTIES OF PYROLYTIC GRAPHITE. R. J. Diefendorf (General Electric Co. Research Lab., Schenectady, N. Y.). Nov. 1960. 14p.

Pyrolytic graphite was made by thermally decomposing a carbonaceous gas on a hot surface. By proper control of the deposition conditions a wide range of materials can be made with properties ranging from hard, relatively isotropic carbons, to soft very anisotropic graphite. In distinction from commercial graphite, pyrolytic graphite is found to approach the theoretical and measured properties of single crystal graphite. Data on the physical properties are presented. (auth)

25128 (ASD-TR-61-2) SYNTHESIS OF INORGANIC POLYMER HIGH TEMPERATURE FLUIDS. G. M. Nichols (Du Pont de Nemours (E. I.) & Co. Eastern Lab., Gibbstown, N. J.). [1961]. Contract AF33(616)-7158. 46p.

Reactions of PCl_5 and NH_4Cl with metal halides yielded compositions composed of a $(PNCl_2)_n$ portion linked to the metal halide. Their exact structure was not rigorously established. Most of the compositions are liquids with a wide liquid range and pyrolytic stability at 1100°F. Metal halides found to exert this effect are $SbCl_5$, $SbCl_3$, $AlCl_3$, $AlBr_3$, BCl_3, BF_3, $TiCl_4$, and $ZnCl_2$. All of the modified products are sensitive to hydrolysis. Two of the $AlCl_3$ compositions were successfully distilled. One had a pour point of −55°C and a b.p. of 420°C/1.1 mm which represents the widest potentially useful liquid range obtained thus far in the project. Viscosity measurements from 0 to 700°F indicate the metal halide stabilized phosphonitrilic chloride liquids have satisfactory temperature-viscosity characteristics. Phenoxy derivatives of cyclic phosphonitrilic chloride trimer, tetramer, oil mixture, and highly polymerized rubber were prepared along with o-biphenylyloxy, mixed phenoxy/o-biphenylyloxy, mixed phenoxy/p-biphenylyloxy, and mixed phenoxy/m-phenoxyphenoxy derivatives of $(PNCl_2)_3$. These compounds, which vary from crystalline solids to viscous liquids, have good hydrolytic stability, very low vapor pressures, and thermal stability up to about 750°F. (auth)

25129 (CF-59-6-109) AN EVALUATION OF ELECTRO-MACHINING FOR THE ANALYSIS OF METAL SURFACES. J. H. DeVan (Oak Ridge National Lab., Tenn.). June 25, 1959. 11p.

A procedure is described for the uniform removal of very thin sections of metal surfaces by electrolysis. Equipment requirements and the various parameters affecting operation are considered, and the results of applying the technique to studies of solid-state diffusion are discussed. The technique appears to offer considerable promise for evaluating chemical changes at metal surfaces which have taken place as a result of corrosion or diffusion processes. (auth)

25130 (NP-10401) RESEARCH IN PHYSICAL AND CHEMICAL PRINCIPLES AFFECTING HIGH TEMPERATURE MATERIALS FOR ROCKET NOZZLES. Semiannual Progress Report. Robert Lowrie (Union Carbide Corp., Research Inst., Tarrytown, N. Y. and Union Carbide Corp. Parma Research Center, Ohio). June 30, 1961. Contract DA-30-069-ORD-2787. 83p.

Mass spectroscopy was used to measure the heats of vaporization and formation for TiB_2 and the heat of vaporization of Al from AlN. The results for AlN indicate a very small evaporation coefficient with an upper limit of 0.01. An evaporation coefficient of 0.8 to 1.0 was obtained for the (110) and (111) planes of Si. Spectroscopic bands believed to arise from LaC_2 are reported. A change was made in the previous tentative assignment of vibration frequencies of B_2O_3. The absorption spectra of matrices of C and C_2N_2 vapor in solid Ar were studied. Studies of graphite-N reactions showed that there is no reaction with molecular N_2 up to 2200°C, but that above 1350°C atomic N reacts with graphite to form C_2N_2. HCN is also produced if adventitious H_2 is present. H_2 reacts with graphite under both static and kinetic conditions to produce C_2H_2 and CH_4 with small amounts of C_2H_6 and C_2H_4; higher hydrocarbons up to C_6 were also produced under some kinetic conditions. The effects of H_2 flow rate and temperature on the H_2-graphite reaction were studied. Thermal conductivities and electrical resistivities were determined at high temperatures for US, CeN, and UN−CeN. Creep studies of MgO single crystals at 1450 to 1700°C are reported. The results of transmission electron microscopic examination of MgO are discussed. The elastic constants of polycrystalline W at temperatures up to 1800°C were calculated from velocity measurements of compressional and shear waves. The thermal expansion and mean lattice-vibration amplitudes of W were obtained up to 1800°C. The lattice parameter of W was found to be increased by annealing in vacuum. Purification progress of refractory compounds is reported. (D.L.C.)

25131 (ORO-448) SYNTHESIS AND FABRICATION OF REFRACTORY URANIUM COMPOUNDS. First Quarterly Report, March 1 through May 31, 1961. K. M. Taylor and C. H. McMurtry (Carborundum Co., Niagara Falls, N. Y.). June 29, 1961. 17p.

Activities in a program to obtain UC pellets of maximum density for irradiation testing are described. A study was made of the effects of the UC powder thermal history, sintering time, sintering temperature, and additives on the UC sinterability. Preliminary results indicate that the UC powder synthesized under the most severe conditions of temperature and time (1740°C, 107 min) was less sinterable than powders prepared at lower temperatures, or at the same temperature for shorter time. It was also concluded that although both temperature and time of sintering pellets affect density, temperature is more important. Additions of Fe (0.1 to 1.0%) improve sinterability and promote grain growth. The final density obtained on sintering in a vacuum was about the same as that resulting from sintering in He at atmospheric pressure. (J.R.D.)

25132 (WADD-TR-60-543) ATTEMPTED SYNTHESIS OF BERYLLIUM HYDRIDE. John C. Powers, Donald W. Vose, and Edward A. Sullivan (Metal Hydrides Inc., Beverly, Mass.). Oct. 1960. Contract AF 33(616)-5847. 36p. (AD-249398)

The direct synthesis of beryllium hydride from the elements was attempted in equipment designed to grind beryllium metal while subjected to heat and hydrogen pressure. Grinding action was supplied by mechanisms which provided the reaction vessels with either reciprocating vertical motion, or motion in which the reactor's horizontal axis described a circle. The ability of both mechanisms to grind

metals satisfactorily was demonstrated in test runs, in which magnesium hydride was synthesized. However, beryllium hydride was not prepared by this method, even when catalytic additives were used. There were no indications even of partial hydriding. Operation with beryllium, which is highly toxic, was carried out safely by conforming to recognized standards of industrial practice. (auth)

25133 NUCLEONICS IN FLIGHT. W. J. Hendry and Walter J. Koshuba (General Electric Co., Cincinnati). Metal Progr., 80: No. 2, 132: 134; 138-9; 142; 144(Aug. 1961).

The manufacture of various fuel elements designed to be a part of reactors for nuclear-powered aircraft and space vehicles is discussed. Progress made in developing high-temperature metals for ceramic coated fuel elements for improved oxidation resistance is described. A 1% Zn—Nb alloy possesses exceptionally good properties for fuel element coatings. Also described are processes for the fabrication of ceramic and cermet fuel elements and the coatings used for the basic uranium dioxide fuels. A brief description is given of auxiliary power systems for space flight. (N.W.R.)

25134 PHYSICAL CHEMISTRY OF PROCESS METALLURGY, PART 1. Metallurgical Society Conferences, Pittsburgh, Pennsylvania, April 27—May 1, 1959. Volume 7. George R. St. Pierre, ed. New York, Interscience Publishers, 1961. 658p. $22.50.

The results and techniques used in physical chemistry of metallurgical phases and oxide phases are presented. Thermodynamic properties, nature and structure of liquid metals, transport and mixing, and solubility and phase equilibria in metal systems are also discussed and described. There are 35 papers presented in this volume. (N.W.R.)

25135 PHYSICAL CHEMISTRY OF PROCESS METALLURGY, PART 2. Metallurgical Society Conferences, Pittsburgh, Pennsylvania, April 27—May 1, 1959. Volume 8. George R. St. Pierre, ed. New York, Interscience Publishers, 1961. 741p. $25.00.

Process control, reaction rates, mechanisms, and statistical methods are presented for metallurgical processes. Other topics included in this volume are: solidification, hydro- and electro-metallurgy, halide and sulfide melt properties, desulfurization in steels, and industrial applications of physical chemistry principles. There are 32 papers in this volume. (N.W.R.)

25136 NUCLEAR METALLURGY. VOLUME VII. A Symposium on Metallic Moderator and Cladding Materials, Fall Meeting of the Metallurgical Society, Philadelphia, October 19, 1960. Metallurgical Society American Institute of Mining, Metallurgical and Petroleum Engineers, Institute of Metals Division, Special Report Series No. 10. New York, American Institute of Mining, Metallurgical, and Petroleum Engineers Inc., 1960. $7.00. 79p.

Eleven papers are included; separate abstracts have been prepared for nine. Two papers were previously abstracted in NSA. (N.W.R.)

25137 MECHANICAL BEHAVIOR OF COLD-WORKED NUCLEAR GRADE ZIRCALOY-2 TUBING. H. H. Klepfer (General Electric Co., Pleasanton, Calif.) and C. N. Spalaris. Met. Soc. Am. Inst. Mining, Met. Petrol. Engrs., Inst. Metals Div., Spec. Rept. Ser. No. 10, 7-18(1960).

The mechanical behavior of a sample from a large order of nuclear grade Zircaloy-2 tubing was studied as part of an over-all materials program. The chemical, metallographic, and crystallographic nature of the tubing is described and related to mechanical behavior. Data indicating the response in the mechanical properties due to annealing, hydrogen additions, and neutron irradiation are presented. (auth)

25138 THE CREEP AND CORROSION BEHAVIOR OF SOME HIGH-STRENGTH ZIRCONIUM ALLOYS. D. L. Douglass (Knolls Atomic Power Lab., Schenectady, N. Y.). Met. Soc. Am. Inst. Mining, Met. Petrol. Engrs., Inst. Metals Div., Spec. Rept. Ser. No. 10, 19-31(1960).

The effects of composition, phase, morphology, and heat treatment on creep and tensile properties and on corrosion in high-temperature water and steam were evaluated for three zirconium ternary systems. Dilute alloys, containing less than 1 at. pct total solute, exhibited corrosion resistance equal to or better than that of Zircaloy-2 but had inferior mechanical properties. Mechanical properties were significantly improved by adding 3 to 7 at. pct solutes; however, the added solute caused a decrease in corrosion resistance. The Zr—Sn—Cb system showed the best combination of creep and corrosion behavior. Zr—Sn—Cr and Zr—Cb—Cr alloys generally were much less corrosion-resistant than Zr—Sn— Cb alloys but could be heat-treated to high strength with considerable improvement in creep resistance. (auth)

25139 ZIRCONIUM ALLOYS FOR CLADDING HIGH-TEMPERATURE FUEL ELEMENTS. R. K. Wagner, H. E. Kline, and D. I. Sinizer (Atomics International, Canoga Park, Calif.). Met. Soc. Am. Inst. Mining, Met. Petrol. Engrs., Inst. Metals Div., Spec. Rept. Ser. No. 10, 33-7 (1960).

A group of zirconium alloys which exhibit good elevated temperature properties were prepared by standard melting and fabricating techniques. Alloy compositions investigated include zirconium alloyed with aluminum, tin, and molybdenum, as well as Zircaloy-2 modified with 0.25% Al and with niobium. To evaluate the effect of the alloy additions, a variety of mechanical tests was performed, over a range of temperatures. A selected group of the alloys were exposed to sodium at 1050 and 1200°F. After a 2500-hr exposure period, the alloys exhibited corrosion characteristics comparable to unalloyed zirconium. In addition, the alloys possess room- and elevated-temperature tensile properties superior to those for either unalloyed zirconium or for the commercial alloy, Zircaloy 2. Substantial increases in creep strength were also achieved by alloying. It was found that the addition of the various alloying elements has no significant effect on the low absorption cross section of zirconium. From these results, it is apparent that the strength requirements for high-temperature fuel element cladding can be satisfied with zirconium base alloys. (auth)

25140 FABRICATION AND PROPERTIES OF APM PRODUCTS. E. G. Kendall and W. H. Friske (Atomics International, Canoga Park, Calif.). Met. Soc. Am. Inst. Mining, Met. Petrol. Engrs., Inst. Metals Div., Spec. Rept. Ser. No. 10, 39-45(1960).

Mechanical strength studies have shown that the tensile and creep properties of aluminum powder metallurgy (APM) products are superior to those of conventional wrought aluminum alloys, at temperatures above 800°F. APM alloy M257 was extruded into several longitudinally-finned tubular shapes for the cladding of nuclear fuels. Techniques for joining APM alloys, including a diffusion bonding process developed for making end closures in M257-clad fuel tubes, are described. (auth)

25141 A REVIEW OF METAL HYDRIDES FOR NUCLEAR REACTOR APPLICATIONS. William M. Mueller

and James P. Blackledge (Univ. of Denver). Met. Soc. Am. Inst. Minning, Met. Petrol. Engrs., Inst. Metals Div., Spec. Rept. Ser. No. 10, 47-50(1960).

Hydrogenous materials are of considerable interest in reactor applications because of the capability of hydrogen to slow down neutrons. Metal hydrides combine high hydrogen retention at elevated temperatures with mechanical properties far exceeding other hydrogenous materials. The requirements for moderators, reflectors, and shields are given and the selection of metal hydrides for these applications is reviewed. (auth)

25142 PHYSICAL PROPERTIES OF YTTRIUM HYDRIDE. Earl S. Funston (General Electric Co., Cincinnati). Met. Soc. Am. Inst. Mining, Met. Petrol. Engrs., Inst. Metals Div., Spec. Rept. Ser. No. 10, 51-6(1960).

Recent developments in yttrium hydride research have made available a material with exceptional high-temperature properties. The usefulness of this material is enhanced by the determination of physical properties necessary for engineering applications. Physical properties, such as melting point, density, electrical resistivity, specific heat, and thermal conductivity, from room temperature to 2000°F are presented. The yttrium-hydrogen equilibrium system is also discussed. (auth)

25143 THE ZIRCONIUM–HYDROGEN SYSTEM. J. B. Vetrano and D. F. Atkins (Atomics International, Canoga Park, Calif.). Met. Soc. Am. Inst. Mining, Met. Petrol. Engrs., Inst. Metals Div., Spec. Rept. Ser. No. 10, 57-61(1960).

Dissociation pressures were used to develop the phase diagram for the Zr–H system, but it was found that this procedure did not provide enough information on the system. X-ray diffraction patterns were determined, and a study was made of work that had been conducted on electrical resistivities and the Hall Coefficient. These data were compared with the dissociation pressure data, in an effort to more clearly define the system. It was determined that examination must be made of other properties, and the present studies extended, before the system can be completely defined. (auth)

25144 MECHANICAL PROPERTIES OF SOLID ZIRCONIUM HYDRIDE. Richard L. Beck and William M. Mueller (Univ. of Denver). Met. Soc. Am. Inst. Mining, Met. Petrol. Engrs., Inst. Metals Div., Spec. Rept. Ser. No. 10, 63-6(1960).

The mechanical properties of zirconium hydride are presented as functions of temperature and composition. These data are interpreted in terms of the phase relations which exist in the zirconium-hydrogen system. The discussion describes why only certain compositional regions are of interest for use as nuclear moderators. (auth)

25145 CLADDING OF DELTA-PHASE ZIRCONIUM HYDRIDE. S. J. Paprocki and E. S. Hodge (Battelle Memorial Inst., Columbus, Ohio). Met. Soc. Am. Inst. Mining, Met. Petrol. Engrs., Inst. Metals Div., Spec. Rept. Ser. No. 10, 73-9(1960).

A study was made of the cladding of solid and powdered δ-phase zirconium hydride with stainless steel. The program included investigations of metallurgical bonding with and without the use of metallic barrier materials. Types 304 and 347 stainless steel were used for cladding materials. The intermediate barrier-layer materials used were niobium, molybdenum, a combination of copper and molybdenum, and a combination of copper and niobium. Bonding techniques involving the use of gas pressure at elevated temperatures were employed in this study to produce solid-state bonding. Variable times and temperatures with a constant pressure of 10,000 psi were utilized. The best results were achieved by cladding δ-phase zirconium hydride directly with Types 304 and 347 stainless steel. Good bonds by direct cladding were obtained by pressure bonding at 1700°F for 3 or 4 hr subsequent to pressure bonding at 1900°F for 1 to 2 hr at a pressure of 10,000 psi. Partial bonding was achieved between niobium and zirconium hydride, and molybdenum and zirconium hydride at higher temperatures. (auth)

25146 IMPROVEMENTS IN OR RELATING TO PRODUCTION OF GRAPHITE. Russell Aves, Thomas Arthur John Jaques, and Frederick Wade (to United Kingdom Atomic Energy Authority). British Patent 873,438. July 26, 1961.

A process is outlined for producing graphite of low porosity for reactor use at high temperatures. In this process, the graphite artifact is impregnated with a metal compound and heated to dissociate the compound and to carburize the free metal. The artifact resulting from the process is graphite with an impervious carbide deposited within its interstices. The preferred metal compound is ZrI_4. (D.L.C.)

25147 IMPROVEMENTS IN OR RELATING TO TREPANNING TOOLS. Frederick James Gale (to United Kingdom Atomic Energy Authority). British Patent 873,505. July 26, 1961.

A trepanning tool is designed with means for removing a solid core of material from a blind hole in a graphite block. The means comprises a wire knife, saw, or file looped around the cutting edge and operable from the shank end of the tool. In operation, after the workpiece has been penetrated to the required depth, the cable is tightened to cut through the central core of material. (D.L.C.)

25148 IMPROVEMENTS IN OR RELATING TO PROCESSES FOR PRODUCTION OF LOW PERMEABILITY CARBON. Herbert Lawrence Rivington (to General Electric Co. Ltd.). British Patent 873,607. July 26, 1961.

A process is outlined for producing low-permeability carbon from carbon of substantially higher permeability. In this process, the carbon is impregnated with furfural either alone or in admixture, the furfural is polymerized under pressure and heat without a catalyst, and the impregnated carbon is heated to carbonize the impregnant. A calcining step at ~1000°C may also be included, and the whole process may be repeated to lower the permeability still further. In examples of the process, permeabilities of $\sim 10^{-3}$ darcys were lowered to $\sim 10^{-5}$ to 10^{-6} darcys in a single application, and five successive applications resulted in a permeability reduction of 10^6. (D.L.C.)

25149 PROCESS FOR DESCALING AND DECONTAMINATING METALS. R. D. Baybarz (to U. S. Atomic Energy Commission). U. S. Patent 2,981,643. Apr. 25, 1961.

The oxide scale on the surface of stainless steels and similar metals is removed by contacting the metal under an inert atmosphere with a dilute H_2SO_4 solution containing $CrSO_4$. The removed oxide scale is either dissolved or disintegrated into a slurry by the solution. Preferred reagent concentrations are 0.3 to 0.5 M $CrSO_4$ and 0.5 to 0.6 M H_2SO_4. The process is particularly applicable to decontamination of aqueous homogeneous nuclear reactor systems. (AEC)

25150 APPARATUS FOR THE PRODUCTION OF LITHIUM METAL. P. S. Baker, F. R. Duncan, and H. B. Greene (to U. S. Atomic Energy Commission). U. S. Patent 2,997,289. Aug. 22, 1961.

Methods and apparatus for the production of high-purity lithium from lithium halides are described. The apparatus is provided for continuously contacting a molten lithium halide with molten barium, thereby forming lithium metal and a barium halide, establishing separate layers of these reaction products and unreacted barium and lithium halide, and continuously withdrawing lithium and barium halide from the reaction zone. (AEC)

25151 NEW METHOD OF GRAPHITE PREPARATION. Stephen D. Stoddard and Wallace T. Harper (to U. S. Atomic Energy Commission). U. S. Patent 2,997,744. Aug. 29, 1961.

A method is described for producing graphite objects comprising mixing coal tar pitch, carbon black, and a material selected from the class comprising raw coke, calcined coke, and graphite flour. The mixture is placed in a graphite mold, pressurized to at least 1200 psi, and baked and graphitized by heating to about 2500°C while maintaining such pressure. (AEC)

Corrosion

25152 (ACNP-6009) INVESTIGATION OF THE CORROSION ASPECTS OF SELECTED ALUMINUM ALLOYS. Pathfinder Atomic Power Plant. Final Report. Karlis Riskevics (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Jan. 31, 1961. For Northern States Power Co. and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 133p.

A literature survey and experimental results from investigations of aluminum corrosion under both static and dynamic test conditions are presented. Static corrosion tests were made on 8001, 8001 + 2.5% Mg and X2219 clad with M400 aluminum alloys. Dynamic corrosion tests were made only on the 8001 alloy. These tests were performed in three identical dynamic corrosion test loops. Initial tests in each loop were made to investigate corrosion behavior in high purity water at high temperatures and high flow velocities. Reproducibility tests were also carried out. An evaluation was made of aluminum-surface-area-to-water-volume-ratio effects on corrosion resistance. Prefilmed sample tests in which test specimens were prefilmed at two different temperatures in a static autoclave prior to the dynamic tests were also made. Results indicated that the corrosion rates of the 8001 aluminum alloy were too high for an economical design of the reactor core. A considerable amount of uncertainty was found to exist in the corrosion literature, as well as in the experimental data, regarding effects of various test parameters on corrosion behavior of this alloy. Time limitations for application to the Pathfinder reactor prohibited further investigation of this material. Consequently, a recommendation of the 8001 aluminum alloy as the boiling water reactor core cladding material, operating at Pathfinder conditions, could not be made. (auth)

25153 (CF-53-5-159) CORROSION OF STRUCTURAL MATERIALS BY PROPYLENEDIAMINE HYDROCHLORIDE. N. A. Krohn and G. A. West (Oak Ridge National Lab., Tenn.). May 22, 1953. Decl. Sept. 29, 1960. 3p.

The corrosion tests were made at room temperature and 55°C on hot and cold rolled steel, types 316 and 347 stainless steel, and Hastelloy C. The results show the stainless steel and Hastelloy C to be unaffected. The hot and cold rolled steels were not affected at room temperature, but at 55°C a brown coating was noted which flushed off easily, leaving a dull surface on the sample. In all cases at 55°C, the propylenediamine phase turned yellow, whereas at room temperature, it remained clear. (B.O.G.)

25154 (GEAP-3698(Rev. 1)) EROSION EXPERIMENTS OF POWDER COMPACTED URANIUM DIOXIDE UNDER DYNAMIC STEAM FLOW. Preliminary Report. C. N. Spalaris, F. A. Comprelli, and M. Siegler (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Mar. 21, 1961. Contract AT(04-3)-189. 35p.

Experiments were carried out to determine the erosion, oxidation, and dimensional characteristics of purposely defected fuel elements containing unsintered UO_2 powder prepared by swaging. The experiments were conducted in an out-of-reactor loop under superheat conditions of pressure, temperature, flow velocity, and steam chemical composition. Uranium dioxide powder escaped in three of seven specimens tested with purposely defected clad. Whether the UO_2 compaction density was a factor in the erosion under dynamic conditions, could not be ascertained from the tests. Additional experiments are in progress to elucidate the conditions leading to UO_2 erosion from powder compacted specimens. Even though the present results are not conclusive, the information may be of interest to those working with powder compaction fuel fabrication techniques. (auth)

25155 (HW-26780) TEST OF WATER QUALITY BY IMPINGEMENT. William C. Houck (Hanford Works, Richland, Wash.). Jan. 8, 1953. Decl. Apr. 28, 1961. 16p.

In order to test the pitting tendencies of different qualities of water, an experiment was performed with jets of water impinging on samples of 72-S Al. Three types of water were used at elevated temperatures. The three types of water were as follows: alum-coagulated water without sodium dichromate, alum-coagulated water plus 2 ppm of sodium dichromate, and ferrifloc-coagulated water without sodium dichromate. (auth)

25156 (NAA-SR-5927) MOLTEN PHOSPHATE REACTOR FUELS. III. MASS SPECTROMETRIC IDENTIFICATION OF GASEOUS CORROSION PRODUCTS OF METALS IN MOLTEN SODIUM POLYPHOSPHATE. L. F. Grantham, M. A. Hiller, T. L. Young, and W. S. Ginell (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 15, 1961. Contract AT(11-1)-GEN-8. 35p.

The corrosion of metals in molten sodium phosphates was studied with a mass spectrometer. Relatively inert alloys (high nickel) as well as reactive alloys (high iron) were studied. The corrosion was studied by observing the mass spectrometric intensity of a volatile corrosion product, P_2, which was shown to be a function of the corrosion rate. Gaseous impurities (H_2O, O_2, CO_2) in the phosphate melts were removed by purging the molten salt with oxygen and argon, in that order. The mass spectrometer proved to be a valuable analytical tool in determining the extent of removal of the gaseous impurities. The effect of the removal of the impurities on the rate of corrosion could not be established conclusively. Above 700°C, a phosphate condensate formed on the cooler parts of the walls of the reaction vessels even when metal samples were not present. This material was identified by an infrared spectrophotometric method as the cyclic sodium trimetaphosphate. No evidence of a volatile phosphate species was found in the mass spectrometer when a heated Knudsen cell containing the melt was placed immediately below the ionization chamber of the spectrometer. Only peaks corresponding to O, Na, NaO, Na_2O, PO, and PO_2 were found as gaseous dissociated products above molten sodium phosphates. It is possible that these dissociation products condensed and rearranged to form $Na_3P_3O_9$ on a cool surface. (auth)

25157 (ORNL-3039) REVIEW AND CORRELATION OF IN-PILE ZIRCALOY-2 CORROSION DATA AND A MODEL FOR THE EFFECT OF IRRADIATION. G. H. Jenks (Oak Ridge National Lab., Tenn.). July 24, 1961. Contract W-7405-eng-26. 42p.

A review and a correlation of many of the data obtained for the in-pile corrosion of Zircaloy-2 in uranyl sulfate solutions at elevated temperatures are presented. The correlation is based on the following equation for the relationship between the corrosion rate, R, and the fission power density in solution, P: $1/R = K_1/KP\alpha + 1/K$, where α is the factor by which the effective power density at the corroding surface is greater than that in the solution and K_1 and K are constants. A semiempirical model for the radiation effects on Zircaloy-2 corrosion which leads to this equation is described and discussed. In the model it is assumed that the major effects of radiation, in interaction with corrosion, are in the metal. The results of the correlation of the experimental data indicate that a general relationship between corrosion rate and solution power density of the form given by the above equation is obeyed within the power-density-range tested (up to 110 w/cc). The extrapolated value of K is essentially independent of solution composition but varies with temperature. The observed values are expressed fairly well by the equation $K = 4.44 \times 10^{10} \exp(-22{,}900/RT)$, where K has the units mpy, and R in this case is the gas constant. The correlations further indicate that the value of the ratio K_1/K does not change appreciably with temperature and has the value of 2.3 w cc^{-1} mpy^{-1} in the temperature range tested (225 to 330°C). The value of α prevailing during exposure depends upon the solution composition and the velocity of solution flow past the test surface. In some solutions the observed value of α is unity even at low velocities. In others, notably those with low concentrations of uranium and other sulfate additives, α values of 6 to 7 or more occur at low velocities. When α values greater than unity occur at low velocities, the values at higher velocities are nearer unity and, under some flow conditions and in some solutions, are equal to unity. The observed α values and the effects of velocity and solution composition are reasonably interpreted in terms of the amounts of uranium sorbed on nonprotective oxides near the specimen surface and the fractional contribution of this sorbed uranium to the total intensity of fission-recoil irradiation of the surface. (auth)

25158 (TID-13345) A STUDY OF THE SURFACE CHEMISTRY BEHAVIOR OF LEAD BY STRAIN ELECTROMETRY. Technical Report Number XL. Charles R. Brinkman and Milton E. Wadsworth (Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes). June 30, 1961. Contract AT(11-1)-82. 49p.

A study of the surface chemistry of lead in aqueous solutions by the technique of strain electrometry was conducted in an effort to show how the transient potentials produced, when straining lead wires, could be used to explain the known corrosion behavior of lead. Measurements were made in solutions in which the pH, dissolved gas content, carbonate ion concentration, and common ion concentration were varied. Several types of high purity lead wires in which there was a difference in trace impurity content were used. Experiments were also conducted with wires that had essentially clean surfaces and with wires covered with heavy deposits of oxides and carbonates. All of these are known to affect the surface behavior of lead in water, and it was found that the transient potentials produced gave a qualitative picture of the reactions and reaction rates that occurred at the lead-solution interface. It was found that the transient potential produced was independent of the strain rate or rate of exposing clean metal surface to distilled water open to the atmosphere, indicating that the interfacial reactions occurring are rather slow. (auth)

25159 (YAEC-147) CORROSION OF SILVER–INDIUM–CADMIUM IN BORATED HIGH TEMPERATURE WATER. D. D. Whyte and A. Krieg (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). June 1960. For Yankee Atomic Electric Company. Contract AT(30-3)-222, Subcontract No. 1. 136p.

The corrosion behavior of bare Yankee Power Reactor control rod alloy (80 Ag–15 In–5 Cd) was evaluated in water corresponding to various simulated phases of reactor operation. The effect of chemical additives, such as boric acid as a soluble neutron poison and lithium hydroxide for pH adjustment, was considered. The bare alloy had previously been found to be undesirable for reactor use primarily due to the possibility of excessive release of corrosion products in the event of a high oxygen accident during operation. Suitably heat treated, electroplated nickel coatings were found to provide protection for the basic alloy in short term tests both with regard to gross attack and to internal oxidation. (auth)

25160 METALLOGRAPHIC OBSERVATIONS ON THE OXIDATION OF BERYLLIUM IN WET CARBON DIOXIDE. R. Smith (Australian Atomic Energy Research Establishment, Lucas Heights, New South Wales). p.147-56 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

A brief account is given of the results obtained from an investigation of the breakaway phenomenon observed when beryllium is oxidized in wet carbon dioxide. Tests were carried out at 700°C in carbon dioxide containing 20000 ppm of water, and the nature of the process was investigated by metallographic methods combined with electron and x-ray diffraction. Breakaway was found to occur more readily on etched surfaces than on machined surfaces, and on metal containing smaller amounts of included oxide. The intergranular nature of the breakaway process is illustrated by photomicrographs, and evidence is presented for the formation of a second reaction product, apart from BeO, at the metal-oxide interface. (auth)

25161 OXIDATION RESISTANCE OF VARIOUS MAGNESIUM ALLOYS HEATED IN CARBONIC ACID GAS UNDER PRESSURE. P. Baque, R. Darras, and C. Chevilliard (Centre d'Etudes Nucleaires, Saclay, France). p.175-94 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In French)

The alloys studied comprise: nuclear magnesium, two Mg–Zr alloys, a ternary Mg–Zr–Zn alloy, a "Magnox" type alloy, and a Mg–Mn alloy. After acetone de-greasing, the samples are chemically etched in a bath of 10% NO_3H in 90% ethyl alcohol, passed through permuted water, then through alcohol, and finally air-dried. The commercial carbonic acid gas used contains less than 300 ppm of oxygen. It is dehydrated and deoxygenated by passing over silica-gel and copper turnings heated to 500°C. Tests were made at pressures of 25 and 60 atmospheres, and at temperatures ranging from 400 to 600°C, using special stainless steel, externally heated autoclaves. The tests usually continue for more than 1000 hours. The equations for the weight increase curves obtained are of the type: $(\Delta p)^n = k \cdot t$ (Δp in mg/cm^2 and t in hours), the exponent n being close to 2. For a given material at a given pressure, oxidation in-

creases with temperature, and at a given temperature, oxidation increases with pressure. Under the same conditions of temperature and pressure, the results obtained vary little with the two surface states studied. The Mg–Zr alloys show a better resistance to oxidation than non-alloyed magnesium. In comparison with other alloys, the Magnox alloy is much less advantageous in carbonic acid gas than in air. In general, the oxidation curves tending to reach a plateau after a certain exposure time, the compatibility with carbonic acid gas of all the alloys considered appears satisfactory, at least up to about 500°C. (auth)

25162 METALLIC CORROSION INHIBITORS. I. N. Putilova, S. A. Balezin, and V. P. Barannik. Translated from the Russian by G. Ryback. New York, Pergamon Press, 1960. 200p.

The theory and practice of applying corrosion inhibitors to metals in aqueous acids, alkalies, and salts; water; atmosphere; and non-aqueous liquid media are given. (N.W.R.)

25163 TEORIYA KORROZII I ZASHCHITY METALLOV. (Metal Corrosion and Protection Theory). N. D. Tomashov. Moscow, Publishing House of the Academy of Sciences, USSR, 1960. 592p.

A detailed study was made of metal corrosion, thermodynamics and kinetics of corrosion processes, corrosion classification, and of basic data on the structure of solids (ionic, atomic, metallic, and molecular bonds and crystal structure). Data on electrolytes are also considered. The corrosion stability of ferrous-base metals and non-ferrous corrosion resistance metals was analyzed. (R.V.J.)

25164 IMPROVEMENTS IN OR RELATING TO ZIRCONIUM ALLOYS. Christopher Tyzack and John Boulton (to United Kingdom Atomic Energy Authority). British Patent 873,362. July 26, 1961.

A Zr base alloy having good corrosion resistance is one containing 0.125 to 0.5 at.% Cu, 0.5 to 2.0 at.% Sn, and balance Zr and impurities. Corrosion data are given for several such alloys in pressurized water at 300 and 325°C. (D.L.C.)

Fabrication

25165 (ACNP-6106) WELDING OF BORON STAINLESS STEEL CONTROL RODS. Pathfinder Atomic Power Plant. Joseph F. Potochnik (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Mar. 1, 1961. For Northern States Power Co. and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 15p.

The results of welding fabrication studies led to the selection of control rods fabricated of ¼-in. flat plates and manually welded with type E308-16 coated stainless steel electrodes. The technique developed is used for fabricating control rods for the Allis-Chalmers Critical Test Facility and the Pathfinder reactor. (B.O.G.)

25166 (AD-254258) BERYLLIUM FORGING PROGRAM, PHASE III. Interim Engineering Report No. 4, March 1, 1960 to December 31, 1960. A. F. Hayes (Ladish Co., Cudahy, Wis.). Contract AF 33(600)-36795. 46p.

Forging tryouts for five beryllium shapes showed feasibility exists for forging unclad beryllium. Die design and sequence of forging operations must provide means of minimizing tensile stresses and confining them to local areas. Two of the five parts were completed, but both developed severe ruptures in the final forging operation. Operations which develop high tensile stresses or which place part, as a whole, in tension, require a positive method for confining beryllium. Future development of forging technique for unclad beryllium will be directed toward keeping metal in restraint during deformation, through use of expendable hot carbon steel support. (auth)

25167 (AERE-M-885) A TECHNIQUE FOR BRAZING STAINLESS STEEL HOLDERS CONTAINING COBALT 60 RADIOACTIVE SOURCES. E. Brown and J. G. Purchas (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1961. 6p.

A method is described for sealing radioactive sources into stainless steel holders by vacuum brazing. Heating is conducted behind a shield by means of a r-f induction coil. The best brazing conditions are predetermined by runs with inactive holders. (D.L.C.)

25168 (GEAP-3487) FAST OXIDE BREEDER PROJECT. II. PRELIMINARY SINTERING STUDIES OF PLUTONIUM–URANIUM DIOXIDE PELLETS. Jesse M. Cleveland and William C. Cavanaugh (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Aug. 15, 1960. Contract AT(04-3)-189. 20p.

A series of brief studies was made in which the effects of various parameters on sintering efficiency of plutonium dioxide–uranium dioxide pellets were noted. Single-pressing produced pellets equaled in sintered density to those pressed twice. The effect of particle size in the range above 40 microns on sintered densities seems to be minor. A minimum temperature in excess of 1500°C is necessary for effective sintering, and a hydrogen–helium atmosphere yields better results than pure helium. A technique was developed for determining pellet densities while sintering and yielded information which reveals that the greater part of densification occurs during the first few minutes of sintering. (auth)

25169 (GEAP-3605) FABRICATION STUDIES OF CLAD COPPER MATRIX BORIDE DISPERSION CONTROL MATERIALS. K. C. Antony (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Dec. 30, 1960. 25p. Contract AT(04-3)-189.

The fabrication of 304 stainless steel clad dispersions of various borides in a copper matrix was investigated. Boride concentration was between 7 and 30 vol %. Two control rod geometries were considered: cylindrical rods and rectangular flat plates. Various methods of fabrication were applied including co-extrusion, braze-diffusion bonding, picture frame rolling, and rectangular tube rolling. The relative advantages and disadvantages of each method with respect to a particular set of design criteria are presented. (auth)

25170 (HW-41884) PILE GRAPHITE CORE BORER. J. M. Davidson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 12, 1956. 7p.

The core borer designed by J. B. Cole for taking samples from graphite moderator was redesigned with a positive screw-type drive to improve cutting of irradiated graphite. A chisel is incorporated in the borer head to automatically cut the saw off in event of sticking. (D.L.C.)

25171 (HW-68789) A FLUX-FREE METHOD FOR JOINING ALUMINUM TO STAINLESS STEEL. L. C. Lemon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1961. Contract AT(45-1)-1350. 15p.

A discussion is given of a method for joining aluminum to stainless steel in the absence of a flux to produce a bond

which is gastight in 120°F water, withstands pressures to 300 psi, and passes a mass spectrometer leak test. Bond strength tests were made in which the aluminum failed at 58,000 psi while the bond remained intact. The aluminum ruptured in tension at 17,300 psi in lap-joined stock while there was no apparent damage to the bond. (B.O.G.)

25172 (MAB-139-M(F3)) STATE-OF-THE-ART REPORT BY THE PANEL ON FORGING AND EXTRUSION OF THE COMMITTEE ON THE DEVELOPMENT OF MANUFACTURING PROCESSES FOR AIRCRAFT MATERIALS (AMC). (National Research Council. Materials Advisory Board). Oct. 15, 1960. Contract DA-36-039-sc-76436. 63p.

Methods of forging and extrusion are discussed. The principal metallic materials currently utilized in aerospace forgings and extrusions, the atmospheres and heating temperatures employed, the several forming techniques available, together with maximum and minimum product dimensions and tolerance approximations were surveyed. Methods of high energy forming as employed in forging and extruding operations are also covered. (M.C.G.)

25173 (MAB-163-M(1)) SECOND PROGRESS REPORT BY THE PANEL ON CASTING AND POWDER METALLURGY. (National Research Council. Materials Advisory Board). Oct. 1, 1960. 23p. Contract DA-36-039-sc-76437.

Limiting factors and apparent research needed to meet future aerospace casting requirements are discussed. A state-of-the-art discussion of powder metallurgy is also presented. (M.C.G.)

25174 (NAA-SR-5616) FABRICATION MODIFICATION DEVELOPMENT FOR OMRE THIRD CORE LOADING. E. Peters and M. H. Binstock (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 15, 1961. Contract (AT-11-1)-GEN-8. 33p.

A description is given of the fabrication of elements for the OMRE third core loading. The elements were made by modification of the process developed for the first core loading, which resulted in decreased costs and increased yields. Thirty-eight fuel elements were produced, two of which were of nonstandard design. One contained special instrumentation to measure peak fuel surface temperatures, and the other contained instrumentation to measure flux distribution across and along the element. Fabrication development for the two special elements is described. (auth)

25175 (NP-9559) DEVELOP PROCESS FOR AND ARC CAST 25 TO 50 POUND INGOTS OF TIN REDUCED MOLYBDENUM. Progress Report for the Period August 31, 1960 thru September 30, 1960. A. D. Abraham (Oregon Metallurgical Corp., Albany). 5p.

Two molybdenum ingots were produced, but both were contaminated during arc melting with water oxidation. Even though oxidized, both contained high residual carbon contents. The silicon content of as-produced molybdenum powder decreased. All components of the purification train appeared to be functioning well. (auth)

25176 (NP-9560) DEVELOP PROCESS FOR AND ARC CAST 25 TO 50 POUND INGOTS OF TIN REDUCED MOLYBDENUM. Progress Report for the Period September 30, 1960 thru October 31, 1960. A. D. Abraham (Oregon Metallurgical Corp., Albany). 5p.

Carbon in the as-produced molybdenum powder was investigated. It was concluded that the source of carbon is the raw materials used. It was not determined whether the cold trap is a further source of carbon-containing gases. The purification furnace apparently has the capacity to reduce the carbon-containing vapor to very low levels on a continuous basis when 33 pounds of metal is used at one time. Another ingot was arc cast but contained high residual carbon due to undetected purification furnace failure during reduction runs. (auth)

25177 (NP-9561) DEVELOP PROCESS FOR AND ARC CAST 25 TO 50 POUND INGOTS OF TIN REDUCED MOLYBDENUM. Progress Report for the Period October 31, 1960 thru November 30, 1960. A. D. Abraham (Oregon Metallurgical Corp., Albany). Contract NOrd-18124. 30p.

The first low-oxygen, low-carbon, low-nitrogen arc-cast ingot was produced. The casting weighed 32 lb, was $3\frac{3}{4}$ in. high and $5\frac{3}{4}$ in. in diameter. No physical testing was begun on the material. A hydrogen gas sample was analyzed and was high in carbon monoxide and nitrogen content. A description of the entire molybdenum facility with photographs is presented. (auth)

25178 (NYO-9186) QUARTERLY PROGRESS REPORT [COATING OF UO_2 AND U METAL SPHERES WITH METALS] FOR PERIOD MAY 16, 1960 TO AUGUST 15, 1960. (Nuclear Materials and Equipment Corp., Apollo, Penna.). Contract AT(30-1)-2264. 40p.

Discussions are given of developments in studies of the coating of UO_2 spheres with Nb–5V, chromium, and molybdenum, and the results of chemical analyses of the coatings. Metallurgical studies were conducted in the extrusion, compaction, heat treatment, and hardness testing of the UO_2 spheres coated with Nb, Nb over Mo, Cr over Nb, Mo, W, and pyrolytic carbon in a Zircaloy-2 matrix. Comparative Knoop hardness values are tabulated for stock metals and sphere coatings from: niobium, chromium, nickel, molybdenum, vanadium, tungsten, and copper. Hardness values are included for coatings of Cr–Ni, Cr–Nb, Ni–Cr, and Ni–Cu. (B.O.G.)

25179 (ORO-433) CHARACTERIZATION OF UO_2 POWDERS. Sixth Monthly Progress Report for March 1961. (Mallinckrodt Chemical Works. Nuclear Div., Hematite, Mo.). Contract AT(40-1)-2699. 5p.

The effects of ball milling on the ceramic performance of twelve UO_2 powders were evaluated. Pellets were prepared from the powders after wet ball milling and their green and fired densities measured. The data indicate that ball milling results in improved density and sintering and that a binder weaker than polyvinyl alcohol is needed for the ball milled UO_2. (D.L.C.)

25180 (SCTM-316-59(16)) THE COLD WELDING OF METALS. D. W. Grobecker (Sandia Corp., Albuquerque, N. Mex.). Jan. 25, 1960. 23p.

Theoretical aspects of cold welding are discussed. An analysis indicated that a three-directional compressive strain condition is required at the interface for ideal cold-weld conditions. In the analysis it is shown why sections to be welded should be narrow and how metal hardness limitations can sometimes be overcome. The importance of metal surface condition is discussed. It is concluded that cold welds are the result of the energy developed when interfacial movement occurs under three-dimensional compressive stresses. Bonding mechanisms in lap welds and shear welds are discussed. (P.C.H.)

25181 (TID-13110) AN EXPERIMENTAL INVESTIGATION OF THE STRESSES AND DEFLECTIONS OF A PERFORATED PLATE IN BENDING. PART I. C. W. Wilson and R. L. Maxwell (Tennessee. Univ., Knoxville. Engineering Experiment Station). June 1961. For Oak Ridge

National Lab. Contract W-7405-Eng-26, Subcontract No. 875. 73p. (ME-61-1)

The measurements were made on a $\frac{1}{4}$-in. thick circular perforated aluminum plate in which the hole diameters were: $\frac{1}{16}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, and 1 inch, with a equilateral triangular pitch of $1\frac{1}{4}$ in. Stresses were kept well below the yield point and deflections were kept well below one-fourth the plate thickness so that plate theory would apply. The deflection measurements were reproducible within 0.001 in. for all tests. The results are compared with measurements made on an unperforated plate as well as a theoretical plate. (B.O.G.)

25182 (NP-tr-651(Pts.I and II)) WELDING OF CHROME–NICKEL AUSTENITE STEELS. (Svarka Khromonikelevykh Austenitnykh Staley). B. I. Medovar—M. S. Soroka, ed. Translated from a publication of the Publishing House of Mashgiz, 1958. (Pt.I, 420p. and Pt.II, 387p.).

A description is given of the basic considerations of the metallurgy and metallography of arc welding of chromium-nickel austenitic steels. Examinations were made of: the causes of hot-crack formation, porosity, and intergranular corrosion in welds; the effects of chemical composition of the weld metal, cold hardening, and heat treatment on phase transformations; and the measures which secure high mechanical properties of the weld metal and ensure its resistance to the formation of cracks, and to intergranular and over-all corrosion. Suggestions are offered regarding the technology and the techniques of flux welding of the most widely used acidproof and heat-resistant austenitic steels. (auth)

25183 PILOT PLANT FOR CERAMIC NUCLEAR FUEL PROCESSES. G. E. Christie and F. S. Martin (Reactor Fuel Element Lab., U.K.A.E.A., Springfields, Lancs, Eng.). Chem. & Process Eng., 42: 308-9; 311-12 (July 1961).

Pilot plant philosophy, process, equipment evaluation, production rates, product testing, and pellet compacting are discussed. Safety procedures, training, and scale-up problems are also briefly discussed. All these topics are discussed with the intent of having high production rates and with techniques that would apply to actual plant production. (N.W.R.)

25184 ELECTROLYTIC POLISHING OF REFRACTORY METALS. F. R. Cortes (Universal-Cyclops Steel Corp., Bridgeville, Penna.). Metal Progr., 80: No. 2, 97-100 (Aug. 1961).

A versatile solution, composed of small amounts of sulfuric and hydrofluoric acids in methanol, is discussed for electropolishing molybdenum, tungsten, tantalum, and niobium. Grinding and polishing procedures are also described. (auth)

25185 A CYANIDE BATH FOR HEAVY GOLD PLATING. Robert Seegmiller and James K. Gore (Los Alamos Scientific Lab., N. Mex.). p. 443-5 of "47th Annual Technical Proceedings [of] American Electroplaters' Society, Inc." Newark, N. J., American Electroplaters' Society, Inc., 1960.

The plating solution contains $KAu(CN)_2$, 30 g/l; KCN, 70 g/l; and turkey red oil, 0.5 ml/l. The cell is operated at 4 to 10 amp/sq ft and 60 to 65°C, with a practical plating rate of up to 1.5 mils/hr. Either gold or stainless steel anodes may be used. Deposits are bright to semi-bright with a slightly reddish cast, smooth, fine-grained, hard, and relatively pore-free. They are more brittle than deposits from industrial type gold baths. Smooth deposits 20 to 30 mils thick are readily obtained. The bath has the ability to produce heavy deposits with good physical properties at rapid plating rates and moderate temperatures. A relatively short useful bath life is one limiting factor on the usefulness of the process. (auth)

25186 THE EXTRUSION OF METALS. Second Edition, Revised. Claude E. Pearson and Redvers N. Parkins. New York, John Wiley & Sons Inc., 1960. 345p.

The principles of extrusion are given for various metals and for various shaped objects. A description is given of the equipment used for hot extrusion of hard metals. Other topics include impact methods, properties of extruded metals, extrusion pressures, metal flow during extrusion both in theory and in practice, and applications of extruded metals. (N.W.R.)

25187 FUEL ELEMENT FABRICATION WITH SPECIAL EMPHASIS ON CLADDING MATERIALS. VOLUME 2. Proceedings of a Symposium held in Vienna, May 10-13, 1960. London and New York, Academic Press, 1961. 391p. £3.11s6d-$10.00-Au.S.260.

Twenty-two papers are included; separate abstracts have been prepared for nineteen. Two papers were previously abstracted in NSA. Five of the papers are in French. The design, fabrication, development, and theory of fuel elements and cladding are presented. These factors are used to produce low-cost and long-lasting fuel material for power reactors. (N.W.R.)

25188 CONTROL OF IMPERMEABILITY OF FUEL ELEMENTS BY AUTOCLAVING IN HELIUM—CASE OF THE REACTOR G2. B. Blanc, S. Choumoff, and M. D'Orival (Centre d'Etudes Nucléaires, Saclay, France). p.3-28 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In French)

In the case of the G2 element, which takes the form of a hermetically closed welded unit, it was decided to adopt a gas autoclaving method whereby the fuel element is placed in an atmosphere of helium under pressure. If the can is defective, the helium penetrates into the interior of the element; the amount of helium which it returns to an evacuated container is then measured. Reference is made to the theoretical aspect of the problem, by means of which the principal parameters can be defined. Details are given of the precautions which allow exceptional sensitivity to be imparted to this method and permit of maintenance of this sensitivity under industrial conditions. Installations operating for more than 2 years and used for testing G2 fuel elements are also described. Operational results are given in conclusion. (auth)

25189 PRODUCTION CONTROL OF ZIRCALOY FUEL CLADDING. B. Nelson U. Nyström, et al. (Atkiebolaget Atomenergi, Stockholm). p.29-44 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

Methods and layout of the Zircaloy cladding control operations in the recently started production of the first charge of fuel elements for the R3/Adam reactor are described. The fuel element design and its expected performance are discussed particularly from the standpoint of being a Zircaloy construction. The control scheme for the Zircaloy material covers incoming half-finished products (tubes, rods), fabrication processes, and finished fuel segments. The more important control methods involve ultrasonic means for crack detection and tube wall thickness measurements, eddy-current testing, x-ray checking of weld junctions, dimensional measurements, helium leak detection, and autoclave corrosion testing. Results and experience so far obtained are reported. (auth)

25190 SOME APPLICATIONS OF MICRORADIOGRAPHY TO FUEL ELEMENT INSPECTION. R. S. Sharpe (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.45-54 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

The principle and techniques of microradiography are described, and the inter-relations between this form of inspection and complementary methods such as optical and electron microscopy are outlined. Initial results of a general review of the potential applications of microradiography to fuel element materials are presented, and the possible extension to dynamic studies of metallurgical changes are discussed. (auth)

25191 ON THE SHEATH DEFECTS OF SWAGED UO_2 FUEL ELEMENTS OF ROD AND HOLLOW TYPES. M. Yokosuka, S. Takahashi, Y. Honda, and Y. Seki (Mitsubishi Atomic Power Industries, Inc., Omiya City, Japan). p.55-72 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

Swaging is a promising low-cost technique for UO_2 fuel fabrication, since repeated dynamical stress is expected to give rise to enhanced atomic rearrangement. Electron micrographs reveal the highly activated sintering even at lower temperatures. This technique, however, is widely believed to result in detrimental formation of cracks and related defects in sheath. Thus, the formation of defects in 304L tubes were extensively investigated. The results have shown that minute cracks generally originate at stress-concentrated portions at and near the inner wall of the sheath. A carbon content less than usual is the most important point for reducing cracks. Electrolytic surface finishing of the sheath inner wall is also very effective. UO_2 powder with high tap density is favorable for reducing total reduction of area needed. For producing hollow fuel rod with double sheaths, a special alloy core is inserted beforehand at the center to avoid wrinkling. Rod and hollow UO_2 fuel elements about 2 m long with no appreciable cracks may be fabricated. Thermal and corrosion tests suggest that they are satisfactory. The maximum density reaches 91 and 95% of the theoretical value for cold and hot swaged rod, respectively. The straightness is within 0.25 mm per m. The fluctuation in density along a rod is within ±0.4%, and fluctuations in diameter and wall thickness are both within 0.02 mm. (auth)

25192 POSSIBLE FABRICATION COST REDUCTIONS v. ENERGY COST. H. Hardung-Hardung (OEEC European Nuclear Energy Agency, Paris). p.201-5 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

Of the total cost of a complete fuel cycle, only a moderate percentage is accounted for by the fabrication of nuclear fuel elements. With prices of raw materials (losses), auxiliary chemicals, and some fabricated parts being fairly stable, a comparatively small margin remains for a reduction of over-all fuel cycle cost. Based on today's (known) technology an estimate is given as to what cost reductions should be technically feasible and of the extent to which these reductions could influence the cost of nuclear energy in nuclear power stations of "conventional" design. (auth)

25193 COATED FUEL PARTICLES. F. Forscher, F. M. Cain, and B. L. Vondra (Nuclear Materials and Equipment Corp., Apollo, Penna.). p.253-66 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

Small particles of UO_2 may be coated with a corrosion-resistant metal to increase thermal conductivity of the compacted fuel filler and to help retain fission gases. Conversely, small particles of uranium metal may be coated with corrosion-resistant metals to block progress of corrosion attack, to randomize the uranium micro-structure in fuel fillers, and to help retain fission gases. The coating of UO_2 particles with adherent, non-porous uniform coatings of ductile chromium, niobium, nickel, tungsten, and molybdenum is described. The particles range in size from 40 to 300 microns while the coating thickness can be from 3 to 150 microns thick. The particles can be compacted into dense fuel material or used as dispersions in a metallic matrix. In the latter case the coating is selected to prevent formation of undesirable intermetallic compounds during fabrication of the fuel element or during its life in a reactor. (auth)

25194 STUDY OF PRODUCTION OF THE "SNOW CRYSTAL" FUEL ELEMENT. M. Gauthron and B. Guibert (Centre d'Etudes Nucleaires, Saclay, France). p.267-84 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In French)

The main problems involved in developing the "Snow Crystal" fuel element are discussed in terms of heat transfer, design of can section, actual production of the fuel element, production of a four-element cell (problem of individual coupling of the elements), and economics. The study ends with a table showing how production of this type of fuel element may be expected to improve both technically and economically. (auth)

25195 EXPLORATORY FUEL ELEMENT RESEARCH. M. J. Whitman (U. S. Atomic Energy Commission, Washington, D. C.). p.287-300 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

Research in progress on potential improvements in fuel element fabrication includes: a process for fabricating thin stainless-steel clad-UO_2-stainless-steel dispersion fuel elements entirely from powder by variations of the slip casting process; the development of techniques for applying the principle of ultrasonic welding to the cladding of plate type fuel elements and the construction of an apparatus for producing fuel plates; and the development of a procedure for fabricating rod type stainless-steel clad-UO_2 fuel elements by hot isostatic pressing. New fuel element concepts are being evaluated which involve: deposition of UO_2 by Plasmatron spray-coating techniques onto cladding alloy sheets and the incorporation of these sheets into fuel elements; the fabrication of a Nb alloy clad UC element; and the infiltration of sodium into a porous body of vibratory compacted uranium metal powder. Metallic yttrium tubing is being evaluated as a container for molten fissionable alloys. Representative research of a more basic nature includes a study of the factors influencing the ductility of Fe–Al alloys and the determination of the susceptibility of austenitic stainless steel to stress corrosion cracking in dilute chloride solutions at elevated temperatures and pressures. (auth)

25196 STUDY FOR THE REACTOR BR-1 OF A PROTOTYPE NATURAL URANIUM FUEL ELEMENT WITH NICKEL BONDING AND ALUMINUM CAN. D. Tytgat (Centre d'Etudes de l'Energie Nucleaire, Mol, Belg.). p.301-10 of "Fuel Element Fabrication with Special Empha-

is on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In French)

In designing the load for the BR 1 reactor (graphite, air, natural U), a study was made of a prototype natural uranium fuel element with nickel bonding and an aluminum can. The different stages described are: stabilization of the uranium metal by thermal treatment, deposit and treatment of a layer of 20 microns of nickel, welding of can by electronic bombardment, and canning under a pressure of 700 kg/cm^2 at 500°C for 1 hr. (auth)

25197 THE DEVELOPMENT OF A COMPLETE POWER REACTOR FUEL INDUSTRY. A. B. McIntosh, H. Rogan, and J. D. Glanville (United Kingdom Atomic Energy Authority, Risley and Sellafield, Eng.). p.311-18 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

The function of the Production Group of the United Kingdom Atomic Energy Authority is to manufacture and supply fuel elements for the British civil power programme, for overseas reactors and the military reactors at Calder and Chapelcross. The history of fuel element research, development, design and production is traced. The present size and extent of effort in terms of manpower and finance is outlined. Figures are given of the capital and running costs for fabrication, testing new designs, and post-irradiation examination of power reactor fuel elements. (auth)

25198 NOVEL CERAMIC FUEL FABRICATION PROCESSES. E. A. Evans (General Electric Co., Richland, Wash.). p.335-70 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

Methods for packaging non-sintered ceramic fuels include compaction by swaging, by applied vibration, by high-energy impact and explosion forming, by isostatic pressing of selectively deformable containers, and, perhaps most simply, by the encapsulation of loosely packed powders. Pre-irradiation evaluation experiments and the extensive irradiation test program in support of these advanced fuel element concepts are summarized. Experience with swaged and vibrationally compacted UO_2 includes fuel element surface heat fluxes approaching 1,000,000 Btu/hr-ft^2, fuel core temperatures in excess of 2750°C, and exposures greater than 5×10^{21} nvt. Cold swaging and vibrational compaction processes were used to fabricate full core length, non-segmented UO_2 fuel elements for the Plutonium Recycle Test Reactor. Details of these fabrication processes, yielding uniform fuel densities near 9.3 gm cm^{-3}, are described. Trends in costs and yields at various stages of process development are summarized. Non-destructive acceptance and quality control tests for cladding tubes and finished fuel elements are described. (auth)

25199 A METHOD OF PRODUCING SHAPED BODIES OF CERAMIC MATERIAL PROTECTIVE AGAINST IONISING RADIATION. Vladimir Lach, Vladimir Potucek, and Jaroslav Slaba. British Patent 871,722. June 28, 1961.

A method is described for producing shaped ceramic shielding from the waste materials of lead extracting and processing plants and aqueous aluminum silicates. The waste materials are mixed in such proportions that 6 to 15 mols $PbOR_2O_3$ (R_2O_3 being oxides contained in the waste materials) correspond to one mol Al_2O_3 and 2 to 2.8 mols SiO_2. The mixture is molded to the desired shape and fired. The shaped bodies may be in the form of plates having edges recessed in such a manner that the adjacent plates of a wall of plates engage and overlap one another. A glazing or synthetic resin is applied to the surface of the plates. (N.W.R.)

25200 METHOD OF OBTAINING UNIFORM COATINGS ON GRAPHITE. I. E. Campbell (to U. S. Atomic Energy Commission). U. S. Patent 2,978,358. Apr. 4, 1961.

A metallic halide in vapor form is passed over a graphite body under such conditions of temperature and pressure that the halide reacts with the graphite to form a coating of the metal carbide on the surface of the graphite. (AEC)

25201 METHOD OF APPLYING METALLIC COATINGS. J. W. Robinson and L. D. Eubank (to U. S. Atomic Energy Commission). U. S. Patent 2,994,951. Aug. 8, 1961.

A method for applying a protective coating to a uranium rod is described. The steps include preheating the uranium rod to the coating temperature, placement of the rod between two rotating rollers, pouring a coating metal such as aluminum-silicon in molten form between one of the rotating rollers and the uranium rod, and rotating the rollers continually until the coating is built up to the desired thickness. (AEC)

25202 METHOD FOR TREATING GRAPHITE PRODUCT. D. H. Gurinsky (to U. S. Atomic Energy Commission). U. S. Patent 2,995,471. Aug. 8, 1961.

A method is described for treating a carbon body with a carbonyl consisting of nickel, iron, and mixtures thereof. The carbonyl is decomposed in a non-oxidizing atmosphere into a mixture of the metal and carbon monoxide on the surface of a carbon body heated to above the decomposition point of the carbonyl. The temperature is increased of the carbon body to an elevated temperature above the point at which a liquid eutectic mixture of the metal and carbon of the carbon body is formed at the surface and below that at which substantial carburization occurs. The elevated temperature is maintained whereby the liquid mixture flows over the surface of the carbon body. The carbon body is cooled below the decomposition temperature of the carbonyl of the metal and to a temperature suitable for forming the carbonyl of the metal. The carbon body is then contacted with carbon monoxide at the carbonyl-forming temperature, whereby carbonyl of the metal is formed in and on the carbon body. The carbonyl is removed from the carbon body by gasifying the carbonyl. (AEC)

Properties and Structure

25203 (AD-249639) MONTHLY PROGRESS REPORT ON PYROLYTIC CARBIDES, DECEMBER 1960. (High Temperatures Inc., Brighton, Mass.). Jan. 11, 1961. Contract NOw-60-0292(FBM). 11p.

Properties were measured for tantalum and niobium carbide coatings prepared by deposition. Some of the properties measured were microhardness, density, lattice constant, etc. (D.L.C.)

25204 (AERE-X/M-178) THE NIOBIUM CARBIDE–URANIUM CARBIDE SYSTEM. K. Whitehead and L. D. Brownlee (Metropolitan-Vickers Electrical Co., Ltd., Manchester, England). May 1957. 14p.

The pseudo-binary system, niobium carbide–uranium carbide, was examined. The melting point-molecular composition curve was established and shown to be almost a straight line giving a very narrow solidus-liquidus loop, and falling from 3485°C, the melting point of niobium carbide, to 2550°C, the melting point of uranium carbide. A complete range of solid solutions was found over the range

1500 to 1900°C, and the lattice parameter-molecular composition curve was shown to be very nearly a straight line. (auth)

25205 (AERE-X/PR-2477) THE ZIRCONIUM CARBIDE–URANIUM CARBIDE SYSTEM. K. Whitehead and L. D. Brownlee (Metropolitan-Vickers Electrical Co., Ltd., Manchester, England). Feb. 1956. 11p. (C.864)

The form of the zirconium carbide–uranium carbide constitutional system was established. Methods for handling the highly pyrophoric uranium carbide powder are described. The melting point curve was determined and is shown to fall smoothly from the melting point of zirconium carbide at 3535°C to that of uranium carbide at 2640°C. The lattice parameter–molecular composition curve is found to be a straight line, and a complete range of solid solutions is shown to exist. (auth)

25206 (AGN-8035) RUBIDIUM AND CESIUM EVALUATION PROGRAM. SPACE POWER SYSTEMS TECHNOLOGY STUDIES. Quarterly Technical Report for Period February 1 through April 30, 1961. Report No. 1. Peter F. Young (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AT(04-3)-368. 11p.

A summary is given of the development of equipment to obtain data for the corrosion and solubility properties of rubidium, and for the corrosion and thermodynamic properties of cesium. (B.O.G.)

25207 (ANL-5700(Pt.C)) DIFFUSION IN URANIUM, ITS ALLOYS, AND COMPOUNDS. Steven J. Rothman (Argonne National Lab., Ill.). May 1961. Contract W-31-109-eng-38. 56p.

A review of laboratory diffusion studies on uranium and its compounds and alloys is presented. Included are results and analysis of studies on diffusion in single-phase and in multiphase U alloys, diffusion of gases in U, and diffusion in UO_2. (J.R.D.)

25208 (ANL-6257) STUDIES OF METAL–WATER REACTIONS AT HIGH TEMPERATURES: I. THE CONDENSER DISCHARGE EXPERIMENT: PRELIMINARY RESULTS WITH ZIRCONIUM. L. Baker, Jr., R. L. Warchal, R. C. Vogel, and M. Kilpatrick (Argonne National Lab., Ill.). May 1961. Contract W-31-109-eng-38. 61p.

The condenser-discharge method of conducting molten metal–water reactions at high temperatures was refined. Two methods to measure energy input to specimen wires and, therefore, to compute initial metal temperatures were developed. Calculated metal temperatures were estimated to be accurate to within 100°C. Two reaction cells were designed, one for operation at atmospheric pressure with water at room temperature, and the other for operation at high pressure and with water at elevated temperature. Means were developed to determine the surface area of metal exposed to reaction and to determine the total extent of reaction. Pressure transducers were used to record the rate of reactions. The zirconium–water reaction was studied with initial metal temperatures from 1100 to 4000°C with 30 and 60-mil wires in room-temperature water. Initial pressures in these runs were the vapor pressures of water at room temperature (20-30 mm). Runs were made with 60-mil wires in water heated to 200°C (225 psi). Results in room-temperature water indicated that the reaction became explosive at an initial metal temperature of 2600°C. Below this temperature, 20% or less reaction occurred. At higher water temperatures, reaction ranged from 40 to 70%. Runs in heated water showed markedly greater reaction, reaching 50% for fully melted metal at the melting point (1840°C). Results suggested that the rates of both solid-state processes and the diffusion of water vapor through the hydrogen blanket surrounding reacting particles must be considered. (auth)

25209 (ANL-6320) THE DIFFUSION OF CHROMIUM IN GAMMA URANIUM. Partial Report–Metallurgy Program 4.1.27. S. J. Rothman (Argonne National Lab., Ill.). June 1961. Contract W-31-109-eng-38. 17p.

The diffusion of tracer amounts of chromium in gamma uranium was studied by the radioactive tracer-sectioning method. The temperature dependence of the diffusion coefficient D is given by $D = 1.98 \times 10^{-3} \exp(-21{,}800/RT) cm^2/sec$, in poor agreement with the data of Mossé, Lévy, and Adda. Possible reasons for the discrepancy are discussed, and it is concluded that the present data are to be preferred as a basis for theoretical studies of the diffusion of tracers in gamma uranium. The difference between the activation energy and that for self-diffusion is also discussed; no conclusions are reached. (auth)

25210 (ANL-6346(p.139-53)) MAGNETIC PROPERTIES OF REACTOR METALS AND ALLOYS. M. V. Nevitt (Argonne National Lab., Ill.).

A survey is made of some of the magnetic properties of metals and alloys of reactor significance, involving principally the thoride elements, Th, U, and Pu, the rare earth elements, and the transition elements, Ti, Zr, and Hf. Some of the important experimental techniques used in magnetic measurements are described briefly. The similarities in the electronic structures of the thorides, rare earths, and transition metals are pointed out and used as a framework for the interpretation of some of the magnetic properties. (D.L.C.)

25211 (ARF-6045-3) STUDY OF THE MECHANISM OF FAILURE OF ROCKET MATERIALS AND MATERIALS RESEARCH. Quarterly Report No. 3. W. K. Sumida and Y. Baskin (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 3, 1961. Contract AF 33(616)-7048. 29p.

The results of dynamic erosion tests on thick-walled graphite cylinders are discussed. Static oxidation tests were conducted and the results correlated with dynamic results and transverse strength determinations. Metallographic analysis was performed on unfired and fired graphite specimens. Zirconium carbide bodies were hot-pressed for testing. Several experimental graphite compositions were fabricated and their microstructural properties are described. (D.L.C.)

25212 (CF-61-5-18) CRACKING IN EGCR STEAM GENERATOR TUBE SHEET. T. M. Kegley, Jr. (Oak Ridge National Lab., Tenn.). May 2, 1961. 9p.

During fabrication of the EGCR steam generator cracking occurred in tube sheet of $1\frac{1}{4}$ Cr-$\frac{1}{2}$ Mo steel. Cracks were found at the torch-cut surface of the tube sheet following oxyacetylene torch cutting and a subsequent 1300°F stress relief. Metallographic examination of specimens containing the cracks showed that the tube sheet had fractured brittlely. The microstructure consisted of ferrite and pearlite which had spheroidized to some extent by the stress relief treatment. Microhardness of the specimens ranged from 132.9 to 218 Vickers hardness (116 to 175 Brinell hardness). It would appear that the brittle fractures resulted primarily from the restraint imposed by the heavy section thickness (12 in.) of the tube sheet. (auth)

25213 (DMIC-46J) STATISTICAL ANALYSIS OF TENSILE PROPERTIES OF HEAT-TREATED Ti–4Al–3Mo–1V AND Ti–2.5Al–16V SHEET. G. H. Beatty and H. R. Ogden (Battelle Memorial Inst. Defense Metals In-

formation Center, Columbus, Ohio). June 6, 1961. 39p. (PB-171425)

The tensile properties, ultimate strength, yield strength, and elongation, of Ti–4Al–3Mo–1V and Ti–2.5Al–16V are examined statistically. When solution treated and aged, Ti–4Al–3Mo–1V has a higher ultimate strength than does Ti–2.5Al–16V, but the two alloys are about even in yield strength and elongation. When solution treated, Ti–2.5Al–16V is unquestionably the stronger. The conclusions are independent of producer. There is not much difference in the same alloy produced by different companies. (auth)

25214 (DMIC-136B) THE EFFECTS OF ALLOYING ELEMENTS IN TITANIUM. VOLUME B. PHYSICAL AND CHEMICAL PROPERTIES, DEFORMATION AND TRANSFORMATION CHARACTERISTICS. D. J. Maykuth, F. C. Holden, D. N. Williams, H. R. Ogden, and R. I. Jaffee (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). May 29, 1961. Contract AF33(616)-7747. 150p. (PB-171424)

Data on the physical, electrical, and chemical properties of titanium alloys are reviewed. Information is presented on the diffusion of interstitial and substitutional elements. The effects of alloying additions on deformation, recovery, recrystallization, and grain-growth characteristics are analyzed, and transformations are discussed in terms of the reaction kinetics. 169 references. (auth)

25215 (DMIC-Memo-115) REVIEW OF RECENT DEVELOPMENTS IN THE TECHNOLOGY OF COLUMBIUM AND TANTALUM. E. S. Bartlett and F. F. Schmidt (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). July 7, 1961. 6p.

A review is presented of major developments in the technology of niobium and tantalum, and their alloys, as reported in information received by DMIC during the period from April through June, 1961. (auth)

25216 (GA-1939) THERMAL CONDUCTIVITY OF REACTOR MATERIALS. Final Report. M. Cutler, H. R. Snodgrass, G. T. Cheney, J. Appel, C. E. Mallon, and C. H. Meyer, Jr. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Jan. 30, 1961. 99p. Contract AT(04-3)-167.

Two new methods for measuring thermal conductivity were applied at high temperatures. The pulse decay method was used to obtain data on zirconium oxide in the temperature range from 600 to 850°C. The necked-down sample method was applied to tantalum, platinum, and molybdenum between room temperature and 1200°C. Good agreement was obtained with existing data. In addition to the theoretical bases and experimental application of these methods, a study of an a-c electrical heating method, some theoretical considerations about heat transport at high temperatures, and comparisons with other techniques for measuring thermal conductivity are presented. (auth)

25217 (KAPL-2111) MECHANICAL PROPERTIES OF ZIRCALOY-2 WELD METAL. S. Beitscher (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 15, 1961. Contract W-31-109-Eng-52. 41p.

Zircaloy-2 weld metal, obtained by inert gas nonconsumable-electrode welding, was subjected to tensile, strain fatigue, and creep-rupture testing. Some of the variables investigated were: temperature, hydrogen content, notch condition, direction, annealing, and strain rate. All the tests indicated that the properties of weld metal and wrought material are not substantially different; however, certain minor differences were observed. The tensile tests indicated that weld metal has slightly lower ductility (as measured by reduction of area) than wrought material under certain testing conditions. No significant difference was found, in the fatigue tests, between the behavior of weld metal specimens, either notched or smooth, and that of wrought specimens. In the creep rupture tests it was observed that weld metal had a slightly higher rupture strength than wrought material under similar testing conditions. It was concluded that the same design criteria can be used for both weld metal and wrought Zircaloy-2 for most reactor applications. (auth)

25218 (KAPL-2146) APPLICATION OF THE EWING EQUATION FOR CALCULATING THERMAL CONDUCTIVITY FROM ELECTRICAL CONDUCTIVITY. A. E. Powers (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 7, 1961. Contract W-31-109-Eng-52. 21p.

The usefulness of the Ewing equation for calculating the thermal conductivity of reactor metals and alloys from electrical resistance, specific heat, density, and atomic weight was investigated. The alloys investigated were Zircaloy-2, HSZA, Nb– 5.5 wt % V, Inconel, 18-8 stainless steel, and eutectic NaK. The Ewing equation was found to give calculated values with a degree of confidence similar to that of actual measured values. (auth)

25219 (LAMS-2562) BIBLIOGRAPHY ON SELF-DIFFUSION OF PURE METALS IN THE SOLID STATE, 1950-1960. Robert L. Andelin and Lois E. Godfrey (Los Alamos Scientific Lab., N. Mex.). May 1961. Contract W-7405-ENG-36. 94p.

Included are 367 references to open literature and unclassified reports published from January, 1950, through December, 1960. Abstracts of articles are not generally included but abstract references are included, as well as occasional notes by the compilers. Temperature dependence equations for self-diffusion coefficients, their method of measurement, and the temperature range of study are listed for original experimental articles reporting these data. A classification of methods for measuring self-diffusion coefficients is presented. A metal index to original experimental articles and a complete author index are also included. (auth)

25220 (NAA-SR-6047) THERMAL EXPANSION OF SNAP MATERIALS. J. D. Watrous (Atomic International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 30, 1961. Contract AT(11-1)-GEN-8. 19p.

Thermal expansion characteristics were determined for the fuel-moderator, reflector, cladding, and engineering materials within the SNAP-2 core vessel. Values were determined for AISI Type 347 stainless steel, Hastelloy N, Be, Zr, ZrH, and zirconium–uranium hydrides, from room temperature to temperatures greater than 1300°F. Derived equations were calculated for these materials, using a least squares analysis. Thermal expansion coefficients for the temperature range of 77 to 1200°F are: 10.34×10^{6} in./in./°F, for Type 347 stainless steel; 7.46×10^{-6} in./in./°F, for Hastelloy N; 9.07×10^{-6} in./in./°F, for Be; and 6.12×10^{-6} in./in./°F, for Zr–7 wt % UH with an $N_H = 6.4$. (auth)

25221 (NAA-SR-6382) THERMAL DIFFUSION IN INTERSTITIAL SOLID SOLUTIONS. D. O. Raleigh and A. W. Sommer (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 30, 1961. Contract AT(11-1)-GEN-8. 22p.

The theoretical relationships for thermal diffusion were applied to interstitial solid solutions. An expression for the steady-state solute activity distribution was derived, which does not require assuming an ideal or regular solution. It is shown that the quantity "heat of transport," or Q*, can be expressed as the sum of two distinct contributions. One of

these is the partial molal heat of solution of the solute, referred to pure solute as the standard state. The second is a portion, designated the thermal gradient effect, which exists independent of solubility relationships. The latter was shown to be obtainable from a plot of log solute activity vs reciprocal temperature, when the activity is referred to pure solute as the standard state. Comparison of the heat of transport with the heat of solution in interstitial solid solutions, where data are available, indicated that the thermal gradient effect is small in these systems. (auth)

25222 (NAA-SR-6385) THEORY OF METAL SURFACE TENSIONS. AN IONIC-SALT MODEL FOR LIQUID METALS. S. W. Mayer (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 30, 1961. Contract AT(11-1)-GEN-8. 10p.

It is shown that the surface tension of molten metals can be calculated by applying the statistical-thermodynamic liquid theory of Reiss et al to an ionic-salt model for alkali, alkaline earth, Group IVB, and Group VB metals. The surface tensions of transition, Group IB, and Group IIB metals were treated on the basis of a monatomic model and the theory of Reiss et al. The melting points of the alkali metals followed a corresponding states law when the ionic-salt model was used. (auth)

25223 (NP-9508) INVESTIGATION OF HIGH TEMPERATURE RESISTANT MATERIALS. Quarterly Report No. 18. May 1, 1960 to July 31, 1960. C. R. Mason, J. D. Walton, C. A. Murphy, and A. T. Sales (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). 37p.

Two tests were attempted to determine the change in thermal conductivity of fused silica as a function of time at a constant mean temperature of 1300°F. No usable data were obtained because of main heater plate burn-out at approximately 1000°F. X-ray data obtained on the unicellular, foamed fused silica evaluated for thermal conduction showed no cristobalite formation. The F-40 arc-plasma unit was investigated to determine the influence of gas flow rates on arc stability and unit efficiency. The data showed that the power losses to the arc gun coolant were approximately 50 to 60% of the indicated power input to the unit, with the greatest loss occurring at lower nitrogen flows. Power output of the unit was found to be from 29 to 35% of the indicated power input. Coefficients of thermal expansion, densities, and tensile strengths were calculated for the following arc sprayed materials: Alumina, titania, zircon, zirconia, chromium carbide, and tungsten. (M.C.G.)

25224 (NP-9574) PARAMETRIC STUDIES OF METAL FIBER REINFORCED CERAMIC COMPOSITE MATERIALS. Interim Report No. 1 [Period Covering] January 8, 1960 through March 7, 1960. Elbridge Z. Stowell and Tien-Shih Liu (Southwest Research Inst., San Antonio). March 8, 1960. Contract NOas 60-6077-c. 10p.

Theoretical discussions are given of probable effects of metallic fibers when embedded in ceramic materials. Conclusions were drawn from geometrical and elastic considerations. Work was started on a survey of pertinent physical and mechanical properties of potential ceramic materials and metal fibers. (auth)

25225 (NP-10366) NONDESTRUCTIVE ANALYSIS OF THE BRITTLE FRACTURE BEHAVIOR OF CERAMIC MATERIALS. Quarterly Progress Report No. 3, March 1, 1961 to May 31, 1961. Joseph L. Pentecost and Julian H. Lauchner (Mississippi State Univ., State College). May 1961. Contract AF 33(616)-7347. 9p.

Surface flaw decorating techniques were developed. Fracture propagation mechanisms were studied under statically stressed states. Fracture discontinuities were associated with occlusion type defects and/or surface abrasion. Capacitance behaviors of polycrystalline materials were studied. Residual stress effects were observed under statically loaded conditions. (auth)

25226 (NP-10411) ALUMINUM BINARY EQUILIBRIUM DIAGRAMS. Technical Paper No. 15. E. H. Wright and L. A. Willey (Aluminum Co. of America. Alcoa Research Labs., New Kensington, Penna.). 1960. 50p.

Phase diagrams are presented for the binary Al alloys of: Ag, As, Au, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cu, Fe, Ga, Ge, Hg, In, K, La, Li, Mg, Mn, Mo, Na, Ni, Pb, Pd, Pr, Pt, Pu, S, Sb, Se, Si, Sn, Ta, Te, Th, Ti, Tl, U, V, W, Zn, and Zr. Tables are included which give the solid solubilities of elements in Al and the properties of intermetallic compounds of Al binary alloys. An extensive bibliography is given. (D.L.C.)

25227 (ORNL-3078) X-RAY AND METALLOGRAPHIC STUDY OF THE NICKEL-RICH ALLOYS OF THE NICKEL–MOLYBDENUM SYSTEM. [PART] II. P. V. Guthrie and E. E. Stansbury (Tennessee. Univ., Knoxville). July 17, 1961. For Oak Ridge National Lab. Contract W-7405-eng-26, Subcontract No. 1114. 57p.

Alloys ranging from 18 to 60 wt % molybdenum were prepared and homogenized in a hydrogen atmosphere at 1250°C for a minimum of 50 hr. Subsequent heat treatments in the temperature range 700 to 1000°C provided information on the progress of phase transformations in the system and, in so far as possible, indicated the equilibrium phase relationships to be expected. The lattice parameter of the α solid solution as a function of molybdenum concentration was determined and used as an aid in establishing the extent of solid solubility of molybdenum in nickel. Molybdenum expands the nickel lattice at the approximately constant rate of 0.0033 A per weight per cent molybdenum. The peritectoid reaction for the formation of the β phase from the α and γ phases was established at 868 ± 2°C, which compares to a previously reported temperature of 840°C. The body-centered tetragonal structure of the β phase was confirmed, although there is evidence for an intermediate structure to form during the process of transformation of the α to the β phase. The etching characteristics of the β phase were observed to be quite variable, depending on the etchant and the rate at which the β has formed from α. In general, etching tends to produce a Widmanstätten pattern presumably associated with the large number of orientations available to β as it forms. Alloys in the composition range between the solubility limit of molybdenum in nickel and the β phase composition develop Widmanstätten structures similar to the pure β phase. The peritectoid reaction for the γ phase was observed at 910°C, which compares to the previously reported 890°C. The γ phase does not possess a simple close-packed hexagonal unit cell as reported earlier. Diffraction studies showed a large number of faint lines which could not be analyzed. Observations indicate that the α phase transforms through one or more intermediate phases in approaching the equilibrium state for the alloy. The sequence frequently involves a precipitation from the α phase, followed by a grain-boundary-nucleated growth process yielding the equilibrium phases. (auth)

25228 (ORNL-3117) INTERDIFFUSION OF HELIUM AND ARGON IN SPEER MODERATOR NO. 1 GRAPHITE (A TERMINAL REPORT ON LARGE-PORE GRAPHITES—EXPERIMENTAL PHASE). Jack Truitt (Oak Ridge National

Lab., Tenn.). June 26, 1961. Contract W-7405-eng-26. 33p.

An experimental investigation of the interdiffusion and forced-flow behavior of helium and argon in Speer Moderator No. 1 graphite was performed. The data were employed to determine a mutual diffusion coefficient and to verify certain superposed-flow equations. In addition, two series of experiments at high values of the forced-flow component were conducted to investigate contributions of the back-diffusion mechanism of those pores whose diameters are equal to or smaller than the mean free path of the gas molecules, approaching Knudsen or free-molecule diffusion. At small forced-flow rates, normal diffusion was the controlling diffusion mechanism, while Knudsen effects were negligible. Flow equations employed previously are applicable to these data. Experiments conducted at high forced-flow rates show the contribution of small channels, which appears to follow the Knudsen diffusion mechanism. A critical value of sweep rate was determined. If the sweep rate is lower than the critical, the contamination will increase, whereas sweep rates greater than this would require large reprocessing capacities without additional decrease in contamination. (auth)

25229 (ORO-437) SURFACE TENSION OF FUSED SALTS. Progress Report, June 1956–March 1957. (Southern Research Inst., Birmingham, Ala.). Mar. 18, 1957. Contract AT(40-1)-2073. 30p.

Fundamental investigations into the surface tension of fused salts are reported. Three experimental methods are considered: sessile-drop, maximum-pull-on cylinder, and maximum-bubble-pressure methods. (C.W.H.)

25230 (ORO-438) SURFACE TENSION OF FUSED SALTS. Progress Report, March 1957–March 1958. (Southern Research Inst., Birmingham, Ala.). Mar. 12, 1958. Contract AT(40-1)-2073. 50p.

Surface tension data are included for several halides. The densities of the fused halides are also given. A study of available techniques for the determination of the interfacial tensions of liquid metal/fused salt systems was undertaken. (C.W.H.)

25231 (PWAC-349) THE ELECTRICAL RESISTIVITY OF LITHIUM AND SODIUM–POTASSIUM ALLOY. Samuel M. Kapelner (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). June 30, 1961. Contract AT(11-1)-229. 33p.

The electrical resistivities of lithium and sodium-44 wt % potassium alloy were measured to 864 and 854 C, respectively, by means of a high precision modified Kelvin bridge circuit. Expressions for the electrical resistivity as a function of temperature were derived by a least squares fit of the data. Estimates of the thermal conductivity of lithium computed from the electrical resistivity data by the Wiedemann-Franz relation indicate a positive temperature coefficient. (auth)

25232 (RADC-TN-60-108) METAL-TO-CERAMIC SEAL TECHNOLOGY STUDY. Third Technical Note Covering the Period December 30, 1959 to March 31, 1960. S. S. Cole, Jr., H. W. Larisch, J. E. Inge, and H. Styhr, Jr., and A. Malan (Sperry Gyroscope Co. Electronic Tube Div., Great Neck, N. Y.). Apr. 1960. Contract AF-30(602)2047. 43p. (AD-240969; NA-8240-8184-3).

Studies undertaken to advance ceramic-to-metal seal technology are discussed. Adherence tests were conducted on approximately 200 metallizing compositions. Torque peel and compression tests were also carried out. Tensile test specimen redesign calculations are presented. Preliminary tensile stress-strain tests were carried out at room temperature. Data from the various tests showed several seals having strengths of 5,000 lb. as measured using the compression tests. A comparison of test methods showed that a tensile value of 25,000 psi is equivalent to a compression test value of 5,200 lb., a drum peel value of 17¼ lb., and a torque peel value of 6⅛ in.-lb. (M.C.G.)

25233 (TID-13302) DIFFUSION STUDIES IN LIQUID METALS. Progress Report, November 1, 1960–June 30, 1961. Richard A. Swalin (Minnesota, Univ., Minneapolis). Contract AT(11-1)-841. 11p.

Self-diffusion studies were carried out in liquid tin from 250 to 1000°C to provide a test for recently developed theories concerning the occurrence of diffusion jumps, and the linearity of the curves produced in plots of the logarithm of the diffusion constant as functions of the reciprocal of the temperature and the absolute temperature. (B.O.G.)

25234 (UCRL-6457) SOME PROPERTIES OF BERYLLIUM OXIDE. J. Lillie (California. Univ., Livermore. Lawrence Radiation Lab.). May 19, 1961. Contract W-7405-eng-48. 23p.

The primary objective of the literature search was to determine the best values for the properties involved in the thermal stress parameter. Comparison of data from various investigators indicates that thermal expansion of beryllia is independent of density. A wide variation was found in the thermal conductivity values of beryllia. Graphs and tables are presented which summarize and compare data from various sources. A bibliography of 53 references for some of the major items of the stress parameter (thermal expansion, thermal conductivity, and modulus of elasticity) as well as for general properties of beryllia is given to books, journals, and reports published from 1914 to 1960. (auth)

25235 (WADC-TR-53-426(Pt.IX)) ORGANO-METALLIC AND ORGANO-METALLOIDAL HIGH-TEMPERATURE LUBRICANTS AND RELATED MATERIALS. Henry Gilman, William H. Atwell, Frank K. Cartledge, Oren L. Marrs, and Gerald L. Schwebke (Iowa State Univ. of Science and Technology, Ames). Apr. 1, 1961. Contract AF33(616)-6463. 177p.

A series of new syntheses was developed for the preparation of so-called custom-made molecules. Also, some older syntheses were improved from the points of view of better yields and more convenient processes. These reactions were applied to the preparation of organo-silicon and related compounds in studies concerned with high temperature fluids and lubricants, as well as antioxidants for high temperature lubricants. (auth)

25236 (ZR-1001-3) DEVELOPMENT OF A HIGH-TEMPERATURE NUCLEAR-RADIATION-RESISTANT PNEUMATIC POWER SYSTEM FOR FLIGHT VEHICLES. Third Monthly Progress Report, Phase 1 Reporting Period November 21, 1960 to December 21, 1960. (Convair, San Diego, Calif.). Contract AF 33(616)-7582. 57p. (AD-249907)

Results are given for preliminary studies of metal alloys suitable for use in pneumatic system components exposed to 1500°F environment. System analyses were made to establish a comparison between a high-pressure system powered by a compressor or a cryogenic gas source and a low-pressure system powered by direct ram air or a cryogenic gas source. (D.L.C.)

25237 (AEC-tr-4760) PLUTONIUM AND ITS METALLURGY. E. Grison. Translated from Mém. sci. rev. mét., 58: 1-10(1961). 22p.

The metallurgy of plutonium is reviewed. Included in the discussion are the problems that its properties pose, the developments to be foreseen in the physical studies, and the principle lines of the technological effort in the course of using plutonium in atomic piles. The properties of the five phases are described. The effects of the phase transformations on fabrication of the metal are discussed. The electronic structure of the outer layers of the atom and its effect on properties was considered. (M.C.G.)

25238 (NP-tr-656) PHYSICS OF METALS AND METAL WORKING. Translation of Selected Articles from Fiz. Metal. i Metalloved., 8: No. 4, 595-8; 622-30(Oct. 1959). 23p.

Presented are translations of studies on the carbide eutectic in nickel-carbon alloys, and the hardness and brittleness of metal-like compounds. Separate abstracts were prepared for each article. (B.O.G.)

25239 (NP-tr-656(p.1-8)) THE CARBIDE EUTECTIC IN NICKEL–CARBON ALLOYS. R. A. Sidorenko. Translated from Fiz. Metal. i Metalloved., 8: No. 4, 595-8(Oct. 1959).

Investigations were made of the reaction between nickel and graphite crucibles in connection with the formation of a carbide eutectic and preventing its disintegration through very fast cooling. Metallographic studies showed the alloy to have a hypoeutectic structure situated in the interdendritic spaces and occupying 5 to 10% of the surface of the microsection. Microhardness measurements resulted in average values of 518 kg/mm^2 for the eutectic, and 303 kg/mm^2 for the matrix. The results of the study were considered to indicate that the properties of Ni–C systems are similar to those of Fe–C systems, and justify the use of Ni–C systems for simulating cast iron. (B.O.G.)

25240 (NP-tr-656(p.9-23)) HARDNESS AND BRITTLENESS OF METAL-LIKE COMPOUNDS. G. V. Samsonov, V. S. Neshpor, and L. M. Khrenova. Translated from Fiz. Metal. i Metalloved., 8: No. 4, 622-30(Oct. 1959).

The microhardness of several metal-like compounds of transition metals was investigated at various loads. The dependence between the microhardness numbers and the load is the same for materials with very high and comparatively low hardness; it is apparently determined by the nature of the plastic deformation of the surface of the solids during microhardness testing. The brittleness of metal-like compounds was investigated by the microbrittleness method. The brittleness indices obtained are in satisfactory agreement with brittleness indices established earlier for some compounds. The brittleness of the compounds increases with the decrease in the mean-square displacements of the centers of molecular complexes in crystal lattices of the compounds, i.e., with an increase in the strength of the interatomic bond and a decrease in the possibility for stress relaxation in the material. The hardness of metal-like compounds increases in the sequence silicide–nitride–carbide–boride, whereas the brittleness increases in the sequence silicide–boride–nitride–carbide. (auth)

25241 (NP-tr-674) STRUCTURE AND MECHANICAL PROPERTIES OF ALLOYED FERRITE. M. M. Shteynberg. Translated from p.63-98 of "Problemy Metallovedeniye i Termicheskaya Obrabotka" (A publication of the Publishing House of the Academy of Science, Moscow, 1956). 86p.

The properties were studied both in the equilibrium and the nonequilibrium states. The dependence of the properties on the grain size and the alloying element was differentiated where ever possible. (B.O.G.)

25242 (UCRL-Trans-676(L)) ABSORPTION OF WATER BY MELTING OXIDES. H. V. Wartenberg. Translated from Z. anorg. u. allgem. Chem., 264: 226-9(1951). 5p.

An interpretation is given of the absorption of water during melting of Al_2O_3, BeO, and La_2O_3, and the release on solidification by spattering. For $Be(OH)_2$, the volatilization at 1000 to 1500°C in water vapor is demonstrated, and thermodynamic reasons are given for the stability of the gaseous hydroxide. (B.O.G.)

25243 PHYSICAL PROPERTIES OF TITANIUM NITRIDE IN THE HOMOGENEITY REGION. G. V. Samsonov and T. S. Verkhoglyadova (Inst. of Metallo-Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Doklady Akad. Nauk S.S.S.R., 138: 342-3(May 11, 1961).

Changes in chemical bonding, and hence in physical properties, can be expected in homogeneous alloys of TiN containing 35 to 50 at. % of nitrogen ($TiN_{0.54}$ to $TiN_{0.98}$). Microhardness tests were run on powder alloys prepared by nitriding powder Ti in a non-oxidizing atmosphere. Electrical resistance measurements were made on sintered briquets which had been subject to a pressure of 2 to 4 tons/cm^2 in a nitrogen atmosphere for 2 to 4 hours at temperatures of 900 to 1300°C. The microhardness increases linearly with increasing nitrogen content of the alloy analogously to the behavior of such carbides as TiC, ZrC, and also Ta_2C and TaC. There is a linear increase in electrical resistance with increasing temperature for the TiN sample containing 49.8 at. % N. On decreasing the nitrogen content to 48.4 at. % N, a maximum in the electrical resistance is found at 1800°C. With a further decrease in the nitrogen content, the electrical resistance increases, and the maximum is shifted toward lower temperatures (750°C for the sample containing 43.4 at. % N, and 550°C for the sample containing 38.6 at. % N). These effects can be explained on the assumption of an increase in ionic bonding in the alloy with a decrease in nitrogen content. These effects should be expected for the nitrides of other transition metals such as Zr, Hf, and V, and also for Nb, Ta, W, and Mo. (TTT)

25244 GENERAL REGULARITIES IN THE STABILIZATION OF SOLID β-SOLUTION IN TITANIUM ALLOYS. N. V. Ageev and L. A. Petrova (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 359-60(May 11, 1961). (In Russian)

The minimum concentrations of alloying additions required in order to obtain a single-phase, β solid solution of titanium on quenching to room temperature are 4.5 to 4.9 at.% Fe, 4.9 at.% Co, 5.0 at.% Mn, 5.8 to 6.3 at.% Ni, 5.8 at.% Mo, 6.0 at.% Re, 8.4 at.% Cr, 8.7 at.% W, 18.4 at.% V, 21.0 at.% Ta, and 23.0 at.% Nb. These minimal critical concentrations of the alloying addition required in order to stabilize the β-phase are equivalent to an average electron concentration of 4.2 electrons per atom. This regularity was verified for the triple alloy systems of Ti–Fe–V, Ti–Fe–Cr, Ti–V–Mo, Ti–Mo–Fe, and Ti–Mo–Mn. Thus it is possible to predict the alloy compositions which will give a single-phase, beta structure on quenching. A ternary phase diagram for Ti–Fe–V is presented as an example. A mixture of $\beta + \omega$ phases are formed if the electron concentration is <4.2 electrons per atom, while the beta phase only is formed at an electron concentration >4.2 electrons per atom. All these ternary systems, which were constructed on the basis of the critical stabilizing concentration of the alloying addition in the corresponding binary systems, followed this rule. (TTT)

25245 PROPERTIES OF LIQUID ALLOYS WITH UNLIMITED COMPONENT SOLUBILITY IN SOLID STATE.

. A. Vertman and A. M. Samarin. Izvest. Akad. Nauk .S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 2, 83-7 Mar.-Apr. 1961). (In Russian)

The viscosity and electric conductivity of Ni–Cu and i–Co melts were tested in helium atmosphere at 1470 › 1590°C. (R.V.J.)

5246 EFFECTS OF ALLOYING ON CERTAIN HYSICAL CHARACTERISTICS OF CHROMIUM AND ICKEL–CHROMIUM ALLOYS. I. G. Polotskii, T. Ya. enieva, Z. L. Khodov, and V. I. Il'chenko. Izvest. Akad. auk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 2, 08-14(Mar.-Apr. 1961). (In Russian)

The influence of diffused W and Fe additions on tensile roperties of Cr and the effects of W and Mo additions on ensile properties of Cr–Ni alloys were studied. Also, ne effects of plastic deformation on the tensile properties f nickel–chromium are reported. The results indicate nat the presence of W in Cr–W alloys does not strengthen ne interatomic bond, while additions of Fe weaken it. dditions of Al slow the decrease of the Jung modulus at 00 to 800°C. The increase of W in Nichrome (0.60 to 2.86 t.% W) increases the Jung modulus and retains the in- reased value for the alloys with larger W concentrations. he increase of Mo from 0.97 to 6.44 at % in Ni–Cr–Mo lloy does not change the modulus of elasticity. The tem- erature curves plotted as functions of the dampening ecrement are quite similar for Nichrome with variable ngsten or molybdenum concentration, but with concen- rations lower than those indicated above and at lower tem- erature the dampening decrement increases sharply. R.V.J.)

5247 DIFFUSION OF BERYLLIUM AND ALUMINUM NTO NIOBIUM. P. M. Arzhanyi, R. M. Volkova, and D. A. rokoshkin. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. auk, Met. i Toplivo, No. 2, 119-21(Mar.-Apr. 1961). (In ussian)

The microstructure of diffusion layers formed by Be and l diffusion into Nb at 900 to 1300°C was studied. The basic onstants for Be and Al diffusion in Nb were calculated, and ne phase composition of beryllium- and aluminum-satu- ated niobium layers was analyzed. (R.V.J.)

5248 THE REACTION OF CERTAIN HIGH-MELTING- OINT CARBIDES AND THEIR SOLID SOLUTIONS WITH ARBONS. K. I. Portnoi, Yu. V. Lebinskii, and V. I. adeeva. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh, Nauk, let. i Toplivo, No. 2, 147-9(Mar.-Apr. 1961). (In Russian)

The melting points and eutectic composition of TiC–C nd NbC–C systems were found. The melting points of rC–C and TaC–C eutectics are in good agreement with ublished data; however, the melting point of the HfC–C utectics was found to be 450°C higher than published data. he eutectic character of the constitution diagrams plotted or the pseudoternary systems TiC–ZrC–C, NbC–ZrC–C, bC–TiC–C, TaC–NbC–C, TaC–TiC–C, and TaC–ZrC– was determined, and the dependence of the temperature f formation of the binary eutectics on the composition of ne carbide phase was established. (R.V.J.)

5249 DEFORMATION-PRODUCED POINT DE- ECTS. Howard K. Birnbaum (Univ. of Chicago) and Floyd . Tuler. J. Appl. Phys., 32: 1403-4(July 1961).

Fine-grained polycrystalline specimens in tension at 7°K were strained to a prestrain E_p. The specimens were ged at a temperature T_α for a time t_a and the tensile de- ormation at 77°K was continued. Upon continuing deforma- on after aging, a yield point was observed and the magni- ude was defined as $\Delta\sigma$. Good results are obtained if $\Delta\sigma$ is assumed proportional to point defect concentrations along the dislocations. It is indicated that the defeat causing the strain aging is the interstitial and that appreciable con- centrations of interstitials are produced by plastic deforma- tion. (L.N.N.)

25250 MAGNESIUM ALLOYS FOR FUEL-ELEMENT COMPONENTS. J. Inst. Metals, 89: 395-400(June 1961).

Discussions are presented on the feasibility of using magnesium and its alloys for fuel element components. The discussions are on such topics as grain boundaries; intergranular cavitations; effects of temperature, stress, and grain size on the mode of fatigue failure; effects of additions of aluminum, lead, and zinc on the fatigue at room temperature and at 250°C; creep resistance; and variation of elongation with temperature for coarse grained alloys. Properties and physical characteristics of special types of alloys are also discussed. (N.W.R.)

25251 ELASTIC-PLASTIC HEAT TENSIONS IN GRAPHITE-COVERED SPHERE-SHAPED FUEL ELE- MENTS. O. Machnig and P. Handge (Arbeitsgemeinschaft BBC-Krupp, Mannheim, Ger.). Kerntechnik, 3: 258-61 (June 1961). (In German)

The efficiency of a reactor depends primarily on the power density. However, high power densities inevitably lead to great temperature variations and therefore to con- siderable heat tensions in the fuel elements. The possibility of using graphite as covering material for sphere-shaped heterogeneous fuel elements is discussed from this view- point. In this connection, the heat tensions in graphite are examined and stated in relation to the output. It is shown that the heat tensions permit high power densities even if the wall thickness of the covering material is relatively great. (auth)

25252 METAL-METAL OXIDE COMPOSITES FOR HIGH-TEMPERATURE USE. Klaus M. Zwilsky (New England Materials Lab., Inc., Medford, Mass.) and Nicholas J. Grant. Metal Progr., 80: No. 2, 108-11 (Aug. 1961).

Given the same base metal, dispersion-strengthened composites are stronger (at higher temperatures and for longer times) than their counterparts in age-hardenable alloys. The superiority of these materials is the result of increased stability which is attributed to their resistance to recrystallization up to temperatures near the melting point of the base metal. Comparisons are given for alumi- num, copper, molybdenum, nickel, and stainless steel systems. (N.W.R.)

25253 THE EFFECT OF INCREASED OXYGEN AND NITROGEN CONCENTRATION ON THE MECHANICAL PROPERTIES OF TITANIUM. E. V. Petunina (Central Scientific Research Inst. of Ferrous Metals, USSR). Metalloved. i Termicheskaya Obrabotka Metal., No. 6, 50- 3(June 1961). (In Russian)

Specimens prepared by powder metallurgy techniques were used for studying the effect of high O and N concen- trations of the metal on the strength of the Ti and of Ti welded joints at various temperatures. The O was intro- duced into the system by mixing TiO_2 with the metal pow- der, then pressing and calcining the mixture while the N content of the specimens was increased by using CaH_2 containing N for the reduction of the Ti powder. It was found that increasing the O concentration to 0.410% results in a considerable increase of the strength of the specimen at room temperature, without impairing the plasticity; this strengthening effect is not preserved when the specimen is heated to higher temperatures. The effect of N on the

strength is considerably more pronounced than that of O, extending to higher temperatures. Weldments behave similarly toward these elements. Formation of cold cracks of welded joints of Ti specimens containing relatively large amounts of O and N is due to stresses resulting from the uneven stress distribution of these elements in the grain during rapid cooling from high temperatures. (TTT)

25254 RATE OF VAPORIZATION OF REFRACTORY SUBSTANCES. R. F. Walker (National Bureau of Standards, Washington, D. C.), J. Efimenko, and N. L. Lofgren. Planetary and Space Sci., 3: 24-30(1961).

Techniques and some preliminary data on the rate of vaporization of aluminum oxide and palladium are presented. Experimental techniques are based on the Langmuir method, using an induction furnace with a microbalance, and on a transpiration-type method using a solar furnace. The vaporization of sapphire in vacuo and water vapor is studied. The data obtained in vacuo could not be fitted to a linear extrapolation of the data of Brewer and Searcy, and possible causes for the discrepancy are discussed. No evidence for a reaction between solid alumina and water could be detected up to 1600°C. During the latter experiments an unexpected attack of platinum by the aqueous atmosphere is encountered. The vaporization of liquid Al_2O_3 is studied in the presence of 2 to 25 mm of H_2O and 0.1 to 1 mm of O_2. A marked reaction between liquid alumina and water vapor is observed. An attempt is made to analyze the data in terms of the reaction: $(1/2)\ Al_2O_3\ (l) + (x/2)\ H_2O(g) = AlO_yH_x(g) + [(3/4) + (x/4) - (y/2)]\ O_2(g)$. The data were not inconsistent with the formation of AlOH molecules. A value of 103 kcal is obtained for heat of vaporization of palladium. The equilibrium vapor pressure is higher than the estimated data of Brewer but lower than the value determined by Haefling and Daane. (auth)

25255 DATA BOOK ON URANIUM DIOXIDE. G. M. Butler, Jr. and Henry H. Hausner, comps. Los Angeles, Gladding, McBean and Co., 1960. 64p.

Methods of preparation, physical properties, effects of particle characteristics, forming and sintering methods, and behavior in reactors are given for uranium dioxide powders. Also included are binary phase diagrams of UO_2 with other ceramic materials which may be used as nuclear fuels. (N.W.R.)

25256 HANDBOOK OF THERMOPHYSICAL PROPERTIES OF SOLID MATERIALS. REVISED EDITION. VOLUME I. ELEMENTS. VOLUME II. ALLOYS. VOLUME III. CERAMICS. VOLUME IV. CERMETS. VOLUME V. LIST OF REFERENCES, AUTHOR INDEX. Alexander Goldsmith, Thomas E. Waterman, and Harry J. Hirschhorn. New York, The Macmillan Company, 1961. 4300p. $90.00.

The materials covered have melting points above 1000°F and are applicable in the design of aircraft, missiles, space vehicles, conventional or nuclear power plants, or allied equipment. The following properties are included: density; melting point; latent heat of fusion, vaporization and sublimation; specific heat; thermal conductivity and diffusivity; emissivity and reflectivity; linear thermal expansion; vapor pressure; and electric resistivity. (N.W.R.)

25257 CONTRIBUTION TO THE DIFFUSION AND CORROSION BEHAVIOUR AND CREEP STRENGTH OF POWDER-BASE ALUMINIUM ALLOYS. R. Weber, U. Zwicker, H. W. Schleicher (Metallgesellschaft A. G., Frankfurt am Main). p.127-45 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

The diffusion of some fission elements in powder-base aluminum materials was investigated and compared with that of cast material (X8001). The diffusion tests were carried out on 300, 400, and 500°C up to more than 1000 hr. Since with organic liquids there may be a water generation, the corrosion behavior of these materials in pressurized water of 300°C and in water vapor of 400°C was investigated. The method of addition of alloying elements was varied and the effects evaluated. Since data are also missing on the effect of alloying elements on the creep resistance, the creep behavior of the aluminum powder-base alloys was examined at 350°C. The results are discussed. (auth)

25258 METALLOVEDENIE URANA I NEKOTORYKH REAKTORNYKH MATERIALOV. (Metallography of Uranium and Certain Reactor Materials). G. Ya. Sergeev, V. V. Titova, and K. A. Borisov. Moscow, Publishing House of Literature on Nuclear Science and Techniques, 1960. 224p.

Metallographic data are given on uranium, uranium alloys, and other materials used in fuel elements with all-metal cores. The data are applied in calculations on reactor design and fuel element manufacture. Thermal and thermomechanical processing of uranium, the effects of radiation and thermal cycles on dimensional stability and complex physico-chemical properties are discussed. Materials for fuel element jackets are analyzed. The book is designed for engineers, scientists, and graduate students doing research. A bibliography of 170 references is included. (R.V.J.)

25259 SOME MECHANICAL AND ELECTRONIC PROPERTIES OF COLUMBIUM, HAFNIUM, AND THEIR ALLOYS. D. J. Maykuth, J. B. Baker, G. S. Root, and G. B. Gaines (Battelle Memorial Inst., Columbus, Ohio). p.10-20 of "Advances in Electron Tube Techniques." [Proceedings of the 5th National Conference. David Slater, ed. New York and London, Pergamon Press, 1961].

Some electronic and mechanical properties of hafnium, niobium, and their alloys are given to assess their use as electron tube materials. The best combinations of hot workability, cold wire-drawing characteristics, and strength and ductility are found with hafnium alloys containing 2.5 and 5% niobium. Because of their gas-sensitive nature and anticipated low secondary-electron-emission coefficients, these alloys show considerable promise for application as grid and/or anode materials. (N.W.R.)

Radiation Effects

25260 (AD-250063) ON THE MECHANISM OF IONIZING RADIATION DAMAGE OF SBR ELASTOMERS. A. D. Delman, B. B. Simms, I. J. Stanley, A. E. Ruff, and E. Goldberg (Naval Material Lab., Brooklyn). Oct. 19, 1960. 27p.

Studies were made of the development of SBR elastomers with improved resistance to attack by high-energy radiation. Changes of molecular structure were investigated by visiometric techniques and gel content measurements. Chemical changes were followed using infrared spectrophotometry. Results indicate that when subjected to radiation doses of 0 to 100 megarep, the polymer is randomly scissioned in toluene. When similarly treated in chloroform, the polymer initially is randomly crosslinked and then the newly formed elastomer network undergoes random scission. The nature of the end-chemical changes is

shown to depend on environmental factors. In the presence of a limited supply of oxygen the polymer is partially oxidized. The oxidation reaction appears to have no influence on the random nature of the degradation process. The external butadiene structures are shown to be more rapidly attacked than the internal groups. The phenyl rings of the styrene groups in the polymer molecule are, on the other hand, only moderately affected in this respect. The results obtained are used to predict the effects of radiation damage to SBR vulcanizates. (auth)

25261 (AD-250514) NGL PLATFORM NUCLEAR RADIATION PROGRAM. First Bimonthly Report [Covering] May 23—July 1960. (Litton Systems, Inc., Beverly Hills, Calif.). Aug. 15, 1960. Contract AF 33(600)-41452. 22p. (BH 59-3461.8)

A literature search was performed concerning the resistance of certain materials, which are a part of the No Gimbal Lock (NGL) platform system, to a nuclear environment. (auth)

25262 (AERE-R-3381) THE DEGRADATION OF PLASTICISED PVC COMPOSITIONS UNDER HIGH LEVEL GAMMA RADIATION. PART 2. I. D. Aitken, H. Wells, and I. Williamson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). May 1961. 45p.

The effect of various fillers on the radiation resistance of polyvinyl chloride compositions was examined. Plasticizers used in previous work together with two types of stabilizer provide the basic polymer blends. (auth)

25263 (BMI-1528) FABRICATION AND IRRADIATION OF SM-2 CORE MATERIALS. Stan J. Paprocki, Ronald F. Dickerson, George W. Cunningham, William E. Murr, and Donald E. Lozier (Battelle Memorial Inst., Columbus, Ohio). July 12, 1961. Contract W-7405-eng-92. 48p.

Irradiation and examination were completed on four capsules of specimens prepared in the SM-2 Core Materials Development Program. Each capsule contained five to eight flat-plate dispersion specimens roll clad with Type 347 stainless steel. Six capsules containing 36 specimens are still under irradiation in the ETR. Variables being studied include use of (1) fuel concentrations of nominal 26 and 40 wt % UO_2 and 34 wt % UN, (2) hydrothermal UO_2, spherical UO_2, and UN fuels, (3) B_4C, NbB_2, and ZrB_2 dispersion poisons and no poison loading, (4) a half-loading of reference ZrB_2 dispersion poison, (5) a boron-10 stainless steel picture frame, and (6) sintering or green pressing alone for core preparation. The specimens in the first capsules underwent burnups of 20 to 40 at % of the uranium-235 at surface temperatures near 700°F. It was found that the burnable poisons, both dispersed in the fuel and alloyed in the cladding, performed satisfactorily. No specimens containing a nominal 40 wt % UO_2 or equivalent UN concentration were included in the first four capsules, but at the 26 wt % loading both the hydrothermal and spherical UO_2 performed well. Encouraging results were obtained for the nonsintered core. (auth)

25264 (HW-SA-2207) RESISTIVITY CHANGES IN ELECTRON IRRADIATED GRAPHITE. I. T. Myers, H. V. Larson, and J. S. Loomis (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [1960?]. Contract AT(45-1)-1350. 17p.

The resistivity changes were measured at electron energies to 2.0 Mev, with reproducibilities to within 0.05%. The damage was found to increase with electron energy. The cross section for lattice atom displacement goes to zero at a threshold energy of 0.150 Mev, corresponding to a value of 30 ev for atom displacement. A graphical representation is given of the resistance changes in graphite as a function of the electron energy. (B.O.G.)

25265 (NP-9594) MONTHLY ACCESSION LIST 41 [ON RADIATION EFFECTS DATA]. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Nov. 15, 1960. 24p. Contract AF33(616)-7375.

References (61) are given to classified and unclassified reports published from 1955 to 1960. A list of 61 REIC publications is given separately. Availability of the documents is given when possible. (P.C.H.)

25266 (NP-10382) UNCLASSIFIED LITERATURE SURVEY ON EFFECTS OF NUCLEAR RADIATION TO ELECTRON—TUBE MATERIALS. Second Quarterly Report, February 1, 1961 through April 30, 1961. Report No. 5735-2. E. R. Johnson (Stevens Inst. of Tech., Hoboken, N. J.). Contract DA-36-039-SC-87382. 19p.

A summary of the major effects of nuclear radiation on vacuum tubes is tabulated. Gas evolution during nuclear radiation and its possible significance is discussed. The use of the omegatron as a possible tool in exploring gas evolution is indicated. (auth)

25267 (NP-10396) MONTHLY ACCESSION LIST 47 [ON RADIATION EFFECTS DATA]. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). May-June 15, 1961. Contract AF33(616)-7375. 22p.

Included are abstracts of 59 articles representing radiation effects studies on electrical and electronic systems, polymers, lubricants, and fluids, metals and ceramics, dosimetry, facilities, and space environments. (B.O.G.)

25268 (NRL-5629) EFFECT OF IRRADIATION TEMPERATURE ON NEUTRON-INDUCED CHANGES IN NOTCH DUCTILITY OF PRESSURE-VESSEL STEELS. L. E. Steele and J. R. Hawthorne (Naval Research Lab., Washington, D. C.). Apr. 13, 1961. 9p.

In an effort to understand more fully the effects of elevated irradiation temperatures on the increase in the ductile-to-brittle transition temperature of two pressure-vessel steels, an experimental assembly containing four groups of specimens of the steels was irradiated in the core of the Oak Ridge LITR. Through the careful design of each unit and by manipulation of the outer experimental containment sheath by air pressure, four different irradiation temperatures, 260, 400, 450, and 550°F, were maintained for the irradiation period. Post-irradiation evaluation of specimens indicated no significant temperature effect for the materials irradiated at less than 450°F, the shift in the ductile-to-brittle transition temperature being about the same for each of the three irradiation temperatures; however, there was a significant effect as a result of irradiation at 550°F, the shift being roughly one-hundred degrees less. The transition-temperature shifts for materials irradiated at less than 450°F were in good agreement with data from earlier experiments in which the specimen temperatures during irradiation were less than 200°F. The shift increases linearly with the logarithm of neutron flux dosage, with data for irradiation below 450°F falling along a single line; the data for materials irradiated at 550°F fall on a line displaced toward lower transition-temperature shifts. (auth)

25269 (REIC-19) THE EFFECT OF NUCLEAR RADIATION ON LUBRICANTS AND HYDRAULIC FLUIDS. S. L. Cosgrove and R. L. Dueltgen (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). May 31, 1961. Contract AF33(616)-7375. 100p.

Basic radiation studies on organic compounds considered significant to lubricant and hydraulic-fluid development are reviewed, and their significance is discussed. Radiation-resistant gas-turbine-lubricant studies led to the development of polyphenyl ethers, alkylated aromatics, and alkylated aromatic ethers. Meta-linked polyphenyl ethers show promise for use between 0 and 800 to 900°F and at dosages up to 10^{11} ergs g^{-1} (C). Inhibited alkylated aromatics, while showing pour points to −50°F suffer from excessive high-temperature coking tendencies. Inhibited aromatic ethers are less radiation-resistant than the polyphenyl ethers, but have a useful temperature range of about −35 to 600°F. Calresearch 59R-439 hydraulic fluid, an inhibited isopropyl-1,9-diphenylonane, is the most promising radiation-resistant formulation. It is superior in most respects to Calresearch 216, an inhibited alkyldiphenyl ether formulation. The combination of radiation-stable fluids (alkylated aromatics) and modified soap (terephthalamates) or nonsoap thickeners (phthalocyanines, arylurea, indanthrene) resulted in greases of adequate radiation stability for anticipated needs. Commercial dry-film lubricants appear to be unaffected by gamma exposures to 2×10^{11} ergs g^{-1} (C). Alkali-metal silicates appear to be satisfactory binders for high-temperature applications, and exposures to 4.4×10^{11} ergs g^{-1} (C) or higher. Metal matrices may be needed for temperatures of 1000°F and simultaneous exposures to 10^{12} ergs g^{-1} (C). Indications are that some existing materials previously considered too unstable, on the basis of static tests, may be acceptable for use in modified components despite extensive radiation-induced property changes. (auth)

25270 DIELECTRIC LOSSES OF NaCl CRYSTALS WITH Ca ADMIXTURE IRRADIATED WITH X-RAYS. M. Kaderka (Inst. of Technical Physics, Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys., B11: 456-7(1961). (In English)

The dielectric properties of unirradiated and 160 kev x-irradiated NaCl single crystals containing 0.5 mole % $CaCl_2$ are studied in electric fields alternating at 10^2 to 10^5 cps. The properties are measured at 20 to 132°C. Several maxima observed in the dielectric losses in the unirradiated crystals are found to disappear upon irradiation. (T.F.H.)

25271 ELECTRON BOMBARDMENT DAMAGE IN SILICON ESAKI DIODES. R. A. Logan, W. M. Augustyniak, and J. F. Gilbert (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 32: 1201-5(July 1961).

The excess current in silicon Esaki diodes was shown to be a sensitive indicator of the density and distribution of states introduced into the forbidden gap by electron bombardment. Both the effects of bombardment and the annealing properties of the radiation damage were found to depend upon the specific donor in the n-type region of the diode. The average bombardment dose of 1-Mev electron/cm^2 needed to increase the excess current density by 1 amp/cm^2 at a bias of 0.3 v is 1.2×10^{16} for P-doped diodes and 0.8×10^{16} for Sb- or As-doped diodes. Upon annealing in an inert atmosphere, at temperature in the range 300 to 400°C, the bombarded diode is restored to its original characteristics. While the annealing studies reveal novel interactions, they show considerable similarity with other work where the radiation damage was monitored by carrier lifetime or conductivity measurements. Structures observed in the I-V characteristics during the annealing indicate that the bombardment-induced levels at $E_v + 0.27$ and $E_v + 0.06$ are due to pairing of a primary defect (probably a vacancy) with an arsenic and a phosphorus impurity atom, respectively. (auth)

25272 X-RAY DIFFRACTION STUDIES OF FISSION FRAGMENT DAMAGE IN URANIUM CARBIDE AND NITRIDE. J. Adam and M. D. Rogers (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 14: 51-3 (Apr. 1961). (In English)

The effects of neutron irradiation on the crystal structures of UC and UN samples are reported. The neutron doses (n) range as high as $1.1 \cdot 10^{18}$ neutrons/cm^2, corresponding to burnup on the order of 3.5 Mwd/te. The damage is measured by the percentage increases in unit cell size in the crystals. It is found that the cell sizes vary as $[1-\exp(-n\gamma)]$, where γ is a function of the material. The numbers of atoms in both UC and UN that are affected per fission event are calculated. (T.F.H.)

25273 EFFECTS OF RADIATION DAMAGE. Nuclear Eng., 6: 283-5(July 1961).

Irradiation damage mechanisms in solids are discussed. Damage to graphite, U and U−Mo alloys, steels, and B-containing systems is studied. Growth, hardening, annealing, and thermal treatment effects are considered. (T.F.H.)

25274 RADIATION DAMAGE IN CERAMICS. J. Howie. Nuclear Eng., 6: 299-303(July 1961).

The effects of reactor-type irradiations on ceramic materials are studied. Discussions are given of damage mechanisms, damage minimization, and recovery from damage. Irradiation-induced changes of properties are outlined for ceramic materials used as fuels, moderators, control elements, and structural members. Materials considered include UO_2, UC, Al_2O_3, BeO, MgO, graphite, SiO_2, $ZrSiO_4$, ZrO_2, TiO_2, $MgO \cdot Al_2O_3$, $2MgO \cdot 2Al_2O_3 \cdot 5SiO_2$, and SiC; and UO_2, UN, and UC dispersed in austenitic stainless steel, graphite, refractory oxides, and SiC. (T.F.H.)

25275 RADIATION EFFECTS IN CLADDING MATERIALS. R. S. Barnes (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.93-104 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

The fast neutron bombardment which a cladding material must sustain displaces atoms, and vacancies are created. These normally migrate and cluster as is seen in the electron microscope. The changes in properties (particularly the mechanical properties) produced by these processes are discussed. Above a certain irradiation temperature clusters do not form and the properties are little changed. However, in some materials, notably beryllium, nuclear transmutations occur, and the products produce permanent effects. Similar effects occur in the inner skin of a cladding material which becomes impregnated with fission products from the fuel during irradiation. The inert gases, which are an important proportion of these products, precipitate as gas bubbles upon dislocations and impede their flow. The material is eventually embrittled and its volume increases. (auth)

25276 POST-IRRADIATION EXAMINATION−AN ESSENTIAL PART OF FUEL ELEMENT ASSESSMENT. V. W. Eldred (United Kingdom Atomic Energy Authority, Sellafield, Cumb, Eng.). p.157-74 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

The techniques employed in the study of irradiated fuel elements from the Calder Hall and Chapelcross reactors are briefly described. They include visual inspection, radiography and leak testing of the complete element; mensuration, density determinations, ultrasonic testing, metal-

lography, thermal conductivity measurements, and mechanical testing on the fuel; and metallography, autoradiography, and mechanical testing on the can. Particular attention is paid to the small number of fuel element failures that have occurred; but much effort is also devoted to following the general behavior of the elements, especially their dimensional stability, under irradiation. Observations made on standard production elements are described. Reference is made to additional facilities, now under construction at Windscale, in which similar examinations will be carried out on a representative selection of elements from the new power stations. (auth)

PHYSICS

General and Miscellaneous

25277 (AD-254027) PIPE DIFFUSION IN LITHIUM FLUORIDE. A. L. Laskar and R. Tucker (Illinois. Univ., Urbana). July 29, 1960. Contract AF[49(638)]-420. 67p. ([AFOSR]-TN-60-1116)

Experiments were performed on LiF crystals to study the diffusion and conductivity characteristics along single or small groups of dislocations. $Na^{24}Cl$ was used as the diffusing material. The results indicate two different processes, an initial current process and a saturation current process having activation energies of 0.74 and 0.97 ev, respectively. The initial process corresponds to diffusion of Na^{24} ions along dislocation lines, while the saturation process corresponds to a poisoning and/or exhaustion of the diffusion process. The conduction current follows Ohm's law in the initial period, while the saturation current follows the relationship $I = AV^2$. Possible mechanisms are discussed. (D.L.C.)

25278 (ANL-6346(p.47-57)) WAVE VELOCITIES IN NONHOMOGENEOUS ELASTIC MEDIA. Wenceslas Jardetzky (Manhattan Coll., New York).

The velocity of wave propagation is easily defined for homogeneous elastic media, but more precision in the definition is necessary in the case of heterogeneous media. Wave fronts are derived from Fourier transforms in the case of one homogeneous media or in layered homogeneous media, but there are no wave equations for potentials in the case of heterogeneous media since the dilation and rotation are coupled. The equations of dynamics for small displacements must be considered simultaneously with the equations of geometric optics. The latter can be interpreted as a certain kind of kinematical constraints. Then the velocity of propagation can be defined from the Malus Law. An exact relationship between the phase velocity and the factor $\beta = \sqrt{\mu/\rho}$ for the two-dimensional case can be easily derived. It is then shown that the phase velocity depends on the period and variations in the amplitude in addition to rigidity and density. (auth)

25279 (ANL-6346(p.58-71)) ULTRASONIC WAVE TRANSMISSION AT PLANE INTERFACES. H. E. Van Valkenburg (Sperry Products, Inc., Danbury, Conn.).

The theory of ultrasonic wave reflection at interfaces is discussed in terms of thin rod, longitudinal, shear (transverse), and Rayleigh (surface) wave velocities. The applications of theory to nondestructive testing are discussed. (D.L.C.)

25280 (ANL-6346(p.72-83)) THEORY OF LAMB WAVES. Roberta A. di Novi (Argonne National Lab., Ill.).

The nature and properties of Lamb waves, that type of stress waves in elastic plates theoretically discovered by Horace Lamb in 1916, are discussed. Emphasis is placed on those properties which make Lamb waves unique when they are compared with other types of elastic wave motion. (auth)

25281 (ARL-TN-60-180) VARIATIONAL TREATMENT OF ELECTRONIC AND MESONIC HYDROGEN MOLECULE IONS. Technical Note No. 53. Anders Frö-man and James L. Kinsey (Uppsala Univ.). Nov. 1, 1960. Contract AF61(052)-351. 19p. (AD-253522)

The Schrödinger equation for three Coulombic particles is formally reduced to an internal one. Solutions to this equation are sought via the variation principle without recourse to the Born-Oppenheimer expansion. Some preliminary calculations for electronic and mesonic isotopic hydrogen molecule ions demonstrate that even very simple trial functions give results comparable to those obtained from conventional Born-Oppenheimer treatments but with considerably less labor. Values for the total energies and internuclear distances for the ground and two lowest excited states are reported along with the separation of the centers of positive and negative charge which exists when the two nuclei have different masses. (auth)

25282 (ARL-TN-340) ON THE POSSIBILITY OF A MODIFIED PERTURBATION SCHEME FOR BOUND STATES INVOLVING DISCRETE SETS ONLY. Technical Note No. 49. S. O. Lundqvist (Uppsala Univ. Inst. of Theoretical Physics). Aug. 15, 1960. Contract AF61(052)-351. 9p. (AD-253523)

A perturbation treatment of a single particle in a potential is formulated so that a discrete set of basis functions are obtained naturally. The case of the perturbed hydrogen atom is considered, and the possibility of generalization of the perturbation scheme to many-electron systems is discussed. (D.L.C.)

25283 (AROD-2810:3) THE SOFT X-RAY CONTINUOUS SPECTRUM FROM LOW ENERGY ELECTRONS IN THE 80A-180A REGION. Technical Report No. 3. T. J. Peterson, Jr. (Cornell Univ., Ithaca, N. Y.). June 1961. 79p.

The intensity distributions in the continuous spectrum of soft x rays over the wavelength range from 80 to 180 A were investigated for various elements and accelerating potentials by means of a grazing incidence vacuum spectrograph with a concave glass grating in a Rowland mounting. Intensity distributions were calculated with the help of previously verified reflecting power coefficients for the grating. The x-ray intensity per unit wavelength interval was found to be proportional to $1/\lambda^{\alpha}$ where α is a number between 1.8 and 3.0. The observed values for α are seen to depend upon target material, accelerating voltage, and angle of observation. The experimental results are compared with the predictions of the basic Somerfeld theory where possible and found to be in good agreement. Details of the apparatus and an outline of the theoretical formulation are presented. (auth)

25284 (HE-150-170) THE ANGULAR DISTRIBUTION OF SPUTTERED POTASSIUM ATOMS. R. P. Stein and F. C. Hurlbut (California. Univ., Berkeley. Inst. of Engineering Research). Jan. 15, 1961. Contract Nonr-222(45). 38p. (AD-253764)

The angular distributions of potassium particles issuing from a potassium surface under bombardment by noble gas ions were observed under moderately good vacuum conditions. Sputtered potassium atoms were detected for incident ion energies above approximately 15 electron volts and useful observations of angular distributions were obtained for incident ion energies in the range 50 to 450 electron volts for all available values of the incident angle. A means was discovered for the discrimination between the total sputtered flux and that fraction of it possessing particle energies above a certain threshold. The apparatus and experimental procedures are described and the observed distribution patterns and the two collision sputtering mechanisms are discussed, along with related observations. (auth)

25285 (HW-SA-2202) STUDIES OF SURFACE SORPTION IN GAS–GRAPHITE SYSTEMS. R. C. Giberson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [nd]. 11p.

For Oral Presentation at the Fifth Biennial Conference on Carbon, June 19-23, 1961.

Sorption of CO_2, CO, and O_2 by clean graphite surfaces was studied. The effects of temperature, flow rate, and graphite impurities and/or surface area on the adsorption rate were determined. Apparent activation energies are ~50 cal/mole, indicating physical adsorption. A maximum value of 1.4×10^{17} chemisorbed sites per gram graphite is proposed. (D.L.C.)

25286 (IS-285) RESEARCH AND DEVELOPMENT REPORT ON THE DIFFERENT CRYSTALLOGRAPHIC PHASES OF SOLID HELIUM. Newton Bernardes (Ames Lab., Ames, Iowa). Apr. 3, 1961. Contract W-7405-eng-82. 10p.

The different crystallographic phases of two stable isotopes of solid helium are analyzed by means of a law of corresponding states. The results of a simple model are also presented, and they indicate the possibility of a new phase for solid He^3 below ~1°K and 50 atm. (auth)

25287 (JPL-TR-32-117) THRUST-UNIT REQUIREMENTS FOR ELECTRICALLY PROPELLED SPACECRAFT. David G. Elliott and Jerome H. Molitor (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). June 10, 1961. Contract NASw-6. 11p.

A preliminary study is presented of the requirements that must be met by electric thrust devices in order to be used with interplanetary spacecraft. Two missions, a Mars orbiter and a Jupiter capture, are analyzed to determine the thrust and specific-impulse requirements of an electric propulsion system. The state-of-the-art of electric thrust devices is discussed, and it is concluded that with expected advances ion motors can meet the requirements, with magnetohydrodynamic motors a promising backup. (auth)

25288 (LA-2533) RADIATION RELAXATION TIMES AT HIGH TEMPERATURES. Douglas H. Sampson (Los Alamos Scientific Lab., N. Mex.). Mar. 1961. Contract W-7405-ENG-36. 65p.

A time-dependent solution to the radiative transport equation was obtained which is valid for an optically thick medium. Its principal value is that it can be used to determine, for a given value of $\partial T/\partial t$ in the case of the energy density or $\partial\rho/\partial t$, $(\nabla\rho)/(\nabla T)$, and $\partial T/\partial t$ in the case of the flux, the approximate boundary of the region of matter temperature T and matter density ρ for which the radiation remains in local thermodynamic equilibrium with the matter. Numerical results for the radiation relaxation time, $c^{-1}\Lambda_t$, for hydrogen in the temperature range $1 \text{ kev} \leq kT \leq 16 \text{ kev}$ were obtained. These results can be transformed to apply to new temperatures or different elements. The upper range of validity of this method is thought to be $\rho \simeq 10^3$ $/cm^3$ and $kT \simeq 64$ kev. However, the transformation equations can be used to obtain a rough estimate of results for higher densities and temperatures. Although it might be expected that $\rho^2\Lambda_t$ would go as ρ in the low density limit where Compton scattering is expected to be dominant, it is found that for low densities $\rho^2\Lambda_t \rightarrow \text{const} \simeq \rho^2\Lambda_a/250$, where $\rho^2\Lambda_a$ is the high density value for $\rho^2\Lambda_t$ due to absorptive processes alone. (auth)

25289 (NASA-TN-D-671) DISCUSSIONS OF SOLAR PROTON EVENTS AND MANNED SPACE FLIGHT. Kinsey A. Anderson (California. Univ., Berkeley) and Carl E. Fichtel (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Mar. 1961. 11p.

Some aspects of predicting the arrival of protons at the earth following the appearance of solar activity features and of forecasting the periods when this penetrating radiation is unlikely to occur are discussed. The composition and duration of solar beams, composed mostly of protons, are being investigated. Prediction criteria based on a comprehensive study of past solar events are being formulated and tested. The flux of protons with kinetic energies greater than 75 Mev in these solar beams was found to vary from about 20 times the normal cosmic ray intensity to about 350 times. (M.C.G.)

25290 (NP-9420) PROJECT SQUID SEMI-ANNUAL PROGRESS REPORT COVERING PERIOD APRIL 1, 1960 TO SEPTEMBER 30, 1960. (Princeton Univ., N. J. Forrestal Research Center). October 1, 1960. Contract Nonr 1858(25), NR-098-038. 96p.

Progress on basic research relating to jet propulsion is reported. Topics covered include: fundamental investigations of nonsteady flow, turbulence, and magnetohydrodynamics; thermal conductivity and viscosity of ammonia and hydrazine; thermal conductivity of gases and liquids over a range of temperatures and pressures; elementary reactions in combustion; high temperature reactions; surface-catalyzed atom and free radical reactions; reaction kinetics in high-temperature gases; inelastic molecular collisions; solid-propellant flame mechanisms; ignition by hot gases, and initiation of detonation by electric spark; transport properties at high temperature and gaseous combustion; magnetohydrodynamics of partially ionized gases; total radiation from burning solid propellants; turbulent flame thermometry; and plasma flow in nozzles. (M.C.G.)

25291 (NP-9563) CHARGED-COLLOID PROPULSION SYSTEM. R. B. Edmonson, C. B. Kretschmer, and L. B. Becker (Aerojet-General Corp., Azusa, Calif.). November 1960. 20p. Contract AF49(638)-656.

Research on the electrostatic spraying of microscopic droplets of oil is summarized. The research is directed toward an understanding of the mechanisms of charge accumulation and electrostatic spraying in high electrical fields. Charge-to-mass ratios and particle size distributions were measured. Effective spraying of Octoil with an additive of tetra-n-butyl ammonium was attained at a pressure of 10^{-6} mm Hg utilizing a porous non-conductive element for feeding the liquid propellant oil mixture. (auth)

25292 (NP-9677) DEVELOPMENT OF ION PROPELLANT SYSTEMS. Quarterly Technical Progress Report No. 1, March 15, 1960–June 15, 1960. (TRW Project No. 512-007944-88). Donald R. Snoke (Thompson Ramo Wooldridge Inc. New Devices Labs., Cleveland). June 24, 1960. 18p. (ER-4117)

An initial report of activities in a program to construct, test, and deliver a prototype propellant system is summarized. Work during the period included literature and industrial surveys, analysis and design studies to select most promising systems, and design of an experimental test program with attention being given to problem areas. (J.R.D.)

25293 (NP-10386) EQUILIBRIUM COMPOSITION OF AIR BELOW 3,000 DEGREES KELVIN INCLUDING ELECTRON DENSITIES. Engineering Paper No. 869. J. M. Fiskin, C. A. Roberts, W. B. Sisco (Douglas Aircraft Co., Inc., Long Beach, Calif.). Sept. 15, 1959. 30p.

Tables of the equilibrium composition of air below

3000° Kelvin are computed in 500° steps. The theory, recent data, and simplifications employed in the calculations are also included in detail. Special emphasis is placed on the electron attachment reactions and the multiplet state degeneracies of atomic oxygen and nitric oxide. The results are compared to previous work in the field wherever possible. (auth)

25294 (ORNL-3125) PHOTON WAVELENGTH AND ENERGY CONVERSION TABLES. C. T. Butler and M. T. Robinson (Oak Ridge National Lab., Tenn.). July 19, 1961. Contract W-7405-eng-26. 16p.

Tables are presented for conversions from photon vacuum wavelength to photon energy and vice versa. The ranges covered are 500 to 12,000 angstroms and 1.000 to 26 electron volts. (D.L.C.)

25295 (P-1861(RAND)) SPACE VEHICLE POWER PLANTS. J. H. Huth (RAND Corp., Santa Monica, Calif.). Dec. 22, 1959. 74p.

Advances in the power conversion field are reviewed. Demands for onboard space vehicle electrical power and those environmental features peculiar to such an operation are discussed. Average power requirements for satellites are described. The environmental factors considered include lack of gravity, high-energy radiation, a meteoroid environment, and heat transfer from the vehicle by radiation only. Chemical, solar, and nuclear powered systems are discussed. Special devices such as magnetohydrodynamic generators are also included. (M.C.G.)

25296 (PR-P-49) PHYSICS DIVISION, PROGRESS REPORT, JANUARY 1, 1961 TO MARCH 31, 1961. (Atomic Energy of Canada Ltd., Chalk River Project, Chalk River, Ont.). 86p. (AECL-1266)

Nuclear Physics Research. Investigations into various properties of nuclear excited states are continuing. Of special interest is a state in Ne^{20} at 5 Mev which was believed to be involved in the thermonuclear reactions producing neon from helium in the stars. The lifetime measured was anomalously long and led to new measurements of the spin and parity. The spin and parity found show that this level cannot be excited in the thermonuclear reactions proposed and have led to revisions in the current ideas about the creation of elements in the universe. Crystal Dynamics of Sodium Iodide. The longitudinal optical vibrations make up the highest frequency branch of elastic waves in a crystal. In these longitudinal waves the ions of opposite charge are moving in opposite phase. Recently the frequency wave-number dispersion relation for this branch in sodium iodide was carefully studied with a constant "Q" spectrometer at the NRU reactor. A specially pure NaI crystal with very small mosaic spread was used. The results confirm a general relation between frequencies and elastic constants, but are in disagreement with predictions of the current "shell model" used for ionic crystals. An analysis of the results may give detailed information on the distortion of the large negative ions induced by the fast coherent motions of the light positive ions. Developments in Theory. Theoretical studies were carried out on a number of problems in connection with power reactor fuel cladding, which include the expansion of UO_2 pellets subjected to a radial temperature variation, the diffusion of oxygen in zirconium metal, and the diffusion of hydrogen in Zircaloy. The (n,α) cross section of O^{16} at energies of 4 to 10 Mev was estimated for use in reactor calculations. The Datatron continues to perform satisfactorily with useful operation being about 450 hours per month. Developments in Electronics. The 900-channel coincidence kicksorter was installed in the Tandem Van de Graaff building and preliminary trials were satisfactory. The encoder used in the 900-channel analyzer was further developed and the improved version will replace the vacuum-tube type now used in the Chalk River 100-channel kicksorter. In addition to increased reliability the temperature stability, differential linearity, and stability against count-rate were all improved. The use of high resolution semiconductor detectors for alpha spectrometry has emphasized the need for extreme stability in pulse height analyzers. To this end work was begun on the stabilization of spectrum position by a control system feeding information related to drift back to the system again. The first results indicate that a considerable improvement in resolution can be obtained. The work on particle detection in scintillating materials by pulse shape discrimination was continued. With a combination of pulse shape and pulse height analysis the following result is obtained: when 99.5% of the gamma-ray pulses from RdTh above 400 kev are rejected by pulse shape discrimination 65% of the 2.5 Mev neutrons detected by the counter from the D(d,n) reaction and 75% of the 14-Mev neutrons from the T(d,n) reaction are counted. (auth)

25297 (SCR-416) ELECTRICAL AND OPTICAL EFFECTS OF SHOCK WAVES IN CRYSTALLINE QUARTZ. F. W. Neilson, W. B. Benedick, W. P. Brooks, R. A. Graham, and G. W. Anderson (Sandia Corp., Albuquerque, N. Mex.). June 1961. 38p.

For presentation at International Colloquium on "Detonation Waves," Paris, France, August 28 to September 2, 1961.

Quartz exhibits a piezoelectric response to shocks of pressures up to at least 300 kb. Up to 25 kb, the positive X-cut output is linear and is useful in a quantitative high-time-resolution technique for recording the profiles of elastic precursor waves in solids. Beyond 50 kb the response is remarkable in that both positively- and negatively-oriented X-cut elements produce positive outputs. This behavior is accounted for by internal conduction of electrons which are produced by ionization at elastic and plastic wavefronts and are accelerated by the piezoelectric field. Photographs of shock-induced optical emission support the ionization-conduction model. (auth)

25298 (TID-12998) STUDIES OF H_2^+ DISSOCIATION. Quarterly Progress Report No. 2, February 15, 1961 through May 14, 1961. A. W. Ehler (Hughes Research Labs., Malibu, Calif.). May 31, 1961. Contract AT(04-3)-362. 4p.

An improved tube consisting of an ion analyzing chamber, dissociation chamber, and current detection chamber was constructed for studying H_2^+ dissociation by electric fields. The performance of the equipment is described. (D.L.C.)

25299 (UCRL-9613) EXPERIMENTS ON ALFVÉN-WAVE PROPAGATION. John M. Wilcox, Alan W. DeSilva, and William S. Cooper, III (California. Univ., Berkeley. Lawrence Radiation Lab.). May 10, 1961. Contract W-7405-eng-48. 35p.

The propagation of torsional hydromagnetic (Alfvén) waves in a cylindrical H plasma is discussed. The hydromagnetic waveguide consists of a Cu cylinder 86 cm long and 15 cm in diameter, filled with H to a pressure of 100 μ and immersed in a uniform axial magnetic field of 16 kgauss. The waveguide is filled with plasma by a type of switch-on ionizing wave that produces a high degree of ionization (80 to 100%) and a temperature of about 10,000°K. Ion densities were measured with an accuracy of about ±15% by observing with a monochromator the profiles of the first three Balmer lines and comparing with a more exact theory of Stark broadening developed by Griem,

Kolb, and Shen. The ion density decreases by a factor of three in 300 μsec because of recombination and diffusion losses. (auth)

25300 (USCEC-83-206) AN ELASTIC COLLISION MODEL FOR THE KINETIC THEORY OF GASES. (TECHNICAL NOTE). Toyoki Koga (University of Southern California, Los Angeles. Engineering Center). June 1961. Contract AF 49(638)-831. 44p. (AFOSR 823)

Investigating previous studies of impact phenomena of various types of particles and considering the convenience of kinetic theoretical treatment of gases, a proposal is made of a semi-empirical model of elastic collisions. With respect to encounters of charged particles, "binary collision" is defined in a new sense. In this model, the collision probability (total cross section) of two particles may be a function of their relative velocity. With respect to a gas composed of two or more types of particles, partitions of momentum and of energy after collisions are plausibly determined, and the conditions which secure the stability of the Maxwell distribution are considered. By this model, analytical treatments of the Boltzmann equation are simplified. The equation may be solved without losing the main characteristics of the pertinent phenomena, even when the state of a gas deviates considerably from thermal equilibrium. (auth)

25301 (AEC-tr-3973(Pt.I)) ADVANCES IN PHYSICAL SCIENCES. Translation of Uspekhi Fizicheskikh Nauk, Volume LXIII, Sept.-Oct. 1957. 632p. (PST-Cat.-112)

A number of surveys and articles are included which give a general idea of the motion of an earth satellite and the scientific research which can be carried out by means of the satellite. Included also are surveys which deal with the history of emission spectroscopy in the USSR, and the present state of development of a number of problems in optics. Separate abstracts were prepared for 8 of the 22 articles included. (B.O.G.)

25302 (AEC-tr-4757) THE CURRENT-DIFFUSION EFFECTS AND ITS APPLICATIONS. Hans Tollert. Translated for Oak Ridge National Lab. from Rheol. Acta, 1: 318-21(1958). 16p. (Includes original, 4p.).

The Magnus effect of the lifting of a sphere while it is being moved by air flow is discussed. This effect was observed in sedimentation experiments, and an alternative name, "current-diffusion effect," is proposed for this phenomenon. The effect was also observed with laminar flow of electrolytes in aqueous solutions and of gaseous mixtures. This effect can be used for the enrichment of the components of binary systems. (D.L.C.)

25303 (NP-tr-662) PROBLEM OF HEAT AND MOISTURE TRANSFER FOR A SEMILIMITED MEDIUM OF THREE MEASUREMENTS FOR BOUNDARY CONDITIONS OF THE SECOND MAGNITUDE. P. V. Tsoy. Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 3: No. 6, 112-19(June 1960). 10p.

Considerations are given for the problem of heat-moisture exchange in a semi-limited medium. The potential function of moisture transfer and the temperature distribution function are found. A solution is given of the problem for the case of uniform distribution of moisture content and constant flow through a plane x = 0. (auth)

25304 (UCRL-Trans-675(L)) HYDRODYNAMICS OF HELIUM II. I. N. Khalatnikov. Translated for Univ. of California. Lawrence Radiation Lab. from Uspekhi Fiz. Nauk, 60: 160(1956). 131p.

A detailed treatment of the hydrodynamics of helium II is presented which discusses pure helium II and solutions containing helium II, sound propagation in helium II, and heat transfer between a solid body and helium II. (D.L.C.)

25305 (UCRL-Trans-678(L)) THEORY OF KINETIC PHENOMENA IN HELIUM II. I. M. Khalatnikov. Translated for Univ. of California from Uspekhi Fiz. Nauk, 59: 673-753(Aug. 1956). 116p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 11, abstract no. 1927.

25306 CRITIQUE OF THE HARVARD METHOD FOR DETERMINING ATOMIC WEIGHTS. Arthur F. Scott (Reed Coll., Portland, Ore.). Anal. Chem., 33: 23A-6; 28-31A (Aug. 1961).

The method is described, and the two sources of error, occlusion by AgX precipitates and the nephelometric end point, are discussed along with anomalies in the nephelometric titration step. Some history of the method is also given. (P.C.H.)

25307 EXPERIMENTS ON MAGNETOHYDRODYNAMIC CO-ROTATION IN MERCURY. Carl-Gunne Fälthammar. Arkiv Fysik, 19: 109-12(1961). (In English)

In an attempt to reproduce on a laboratory scale the astrophysical phenomenon of co-rotation, experiments were performed which show in a qualitative way the influence of a strong magnetic field on the motion of a conducting liquid surrounding a rotating sphere. (auth)

25308 REMARKS ON THE LATTICE DYNAMICS OF ALKALI HALIDE CRYSTALS. Stig O. Lundqvist (Univ. of Uppsala). Arkiv Fysik, 19: 113-21(1961). (In English)

Physical assumptions in previous treatments of lattice vibrations are considered, and it is shown that the proposed scheme is not restricted to the Heitler-London approximation. The physical content of the proposed scheme is clarified and shown to be essentially the same as the shell model. (D.E.B.)

25309 ON THE ELECTROMAGNETIC BEHAVIOUR OF A PLASMA. Ernst Åstrom (Royal Inst. of Tech., Stockholm). Arkiv Fysik, 19: 163-218(1961). (In English)

A plasma resonator experiment gives several resonances, whereas theory predicts only one for a homogeneous zero-temperature plasma cylinder of circular cross section. A theory is presented that predicts: that also an inhomogeneous plasma cylinder generally has only one dipole resonance; that a deformation of the cross section or introduction of a longitudinal magnetic field splits the resonance into two; and that an elementary model of a plasma of non-zero temperature gives an infinite series of resonances. This theory agrees qualitatively with the experimental results. The surface on which the dielectric constant vanishes in an inhomogeneous plasma constitutes a mathematical singularity. A suitable treatment is presented that resolves the paradox of losses in a plasma where, by assumption, there are no collisions. (auth)

25310 PAIR COUPLING IN p^2f WITH APPLICATION TO O II. Karl Börje S. Eriksson (Univ. of Lund). Arkiv Fysik, 19: 229-33(1961). (In English)

Formulas were derived for the structure of p^2f in intermediate pair coupling, and are shown to give an accurate description of O II $2s^22p^2nf$. (auth)

25311 THE X-RAY L-ABSORPTION SPECTRUM OF SILVER. A STUDY WITH BENT CRYSTAL AND PROPORTIONAL COUNTER. Bertil Nordfors (Uppsala Univ.). Arkiv Fysik, 19: 259-88(1961). (In English)

A bent crystal vacuum spectrometer is described as well as the detector system employing a proportional counter. The three L-absorption edges of silver are recorded in such a way that the absolute value of the mass absorption coefficient is determined as a function of wavelength, and curves of these functions are published. Special attention

is paid to the fine structure in the absorption spectra within a region of around 60 ev on the high energy side of the absorption limit. The influence of the resolving power of the spectrometer on the recorded spectra is discussed. The wavelengths and energies of the absorption limits are measured, with the following results: L_{III}: λ = 3692.1 XU, E = 3351.0 ev; L_{II}: λ = 3509.3 XU, E = 3525.5 ev; L_I: λ = 3249.8 XU, E = 3807.0 ev. (auth)

25312 PHOTOSENSITIVITY AND SPEED OF RESPONSE IN CADMIUM SULPHIDE. D. Shaw (Associated Electrical Industries, Ltd., Rugby, Eng.). Brit. J. Appl. Phys., 12: 337-41(July 1961).

The photoconductivity and photocurrent decay time at 875 foot candles were measured for over ninety crystals of cadmium sulfide of widely different photosensitivities. The same parameters were also measured over the illumination range 0.007 to 875 foot candles for a smaller number of crystals. At 875 foot candles a clear correlation between photoconductivity and decay time was observed. The performance of all the crystals was limited by trapping. Evidence for two types of trap was obtained. (auth)

25313 ON RELATIVE DOUBLET LINE STRENGTHS IN THE PRINCIPAL SERIES OF CESIUM. W. Hanus (Nicholas Coperincus Univ., Torun, Poland). Bull. acad. polon. sci. Sér. sci., math., astron. et phys., 9: 287-91 (1961). (In English)

The relative doublet line strengths in the principal series of cesium are computated using the Fermi formula. The spin-orbit interaction and the necessary number of radial integrals are known for these calculations. The results obtained are compared with theoretical assumptions. N.W.R.

25314 CATHODE SPUTTERING OF Cu AND Pb SINGLE CRYSTALS BY HIGH ENERGY A^+ IONS. Brana Dj. Perović. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 37-43(Mar. 1961). (In English)

The dependence of cathode sputtering intensity on crystallographic directions of the target for single crystals of Cu and Pb was investigated. The extracted ion beam of Ar^+ with the energy of 10 to 25 kev was used. The correspondence between the obtained spots of the sputtered material and the crystallographic directions of the target was observed by means of the simultaneous stereographic projection. The directions of the most intensive sputtering correspond to the (110) and (100) lattice directions, similarly to those obtained in the low energy range. The density distribution of the spot deposit was investigated by a microphotometer and the bombarded surface by a stereomicroscope. (auth)

25315 INVESTIGATION OF THE CHARACTERISTICS OF THE ION SORPTION IN A BAYARD-ALPERT IONIZATION TUBE. Branka Čobić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 45-57(Mar. 1961). (In English)

The phenomenon of gas disappearance in the presence of electron beams due to interaction of positive ions with the glass envelope of a Bayard-Alpert ionization gage was investigated in a gas static system under ultra-high vacuum conditions. Relations between ion sorption speed and the quantity of ions which can be sorbed on the glass envelope were investigated for He, Ne, Ar, Kr, and Xe and the active gases N_2 and H_2. Dependence of the above quantities upon the parameters of ion energy, gas pressure, electron current, and temperature of the walls was investigated and the results interpreted in terms of a spectrum of favored sorption sites model. (auth)

25316 NEUTRONOGRAPHIC INVESTIGATION OF THE CUBIC MODIFICATION OF PbF_2. I. I. Yamzin, Yu. Z. Nozik, and N. V. Belov (Inst. of Chrystallography, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 138: 110-11(May 1, 1961). (In Russian)

The high-temperature modification of PbF_2 belongs to the structural type of CaF_2, but a study by x rays is difficult because of the large difference in atomic amplitudes of fluorine and lead ($Z_F = 9$, $Z_{Pb} = 82$). The respective amplitudes for nuclear congruent scattering of neutrons are more favorable at $b_F = +0.55 \times 10^{-12}$ cm and $b_{Pb} = +0.96 \times 10^{-12}$ cm. Single crystals of PbF_2 were used to obtain 32 reflections from the {1 0 0} and {1 1 0} planes on a neutron diffractometer. The measured neutron intensities and values of $L\sigma$ and $L\sigma^2$ are computed on the assumption of a CaF_2 structure with coordinates of the basal atoms of Pb(0,0,0), $F_1(\frac{1}{4},\frac{1}{4},\frac{1}{4})$, and $F_2(\frac{3}{4},\frac{3}{4},\frac{3}{4})$, where $L = 1/\sin\theta$ is the Lorentz factor, while the structural amplitude ϕ_{hkl} for a Fm 3 m spatial group has the form: $\phi_{hkl} = f_{Pb} + 2f_F$ at $h + k + l = 4n$, $\phi_{hkl} = f_{Pb}$ at $h + k + l = 2n + 1$, and $\phi_{hkl} = f_{Pb} - 2f_F$ at $h + k + l = 4n + 2$. The cubic modification of PbF_2 actually is structurally similar to calcium fluoride. The use of neutron diffraction avoids the difficulties associated with the detection of a light atom in the presence of a heavy atom. The F contribution to the intensity of reflections with an index sum which is a multiple of 4 n even exceeds the contribution from the much heavier lead atom. (TTT)

25317 LUMINESCENCE OF LiF CRYSTALS ACTIVATED BY URANYL NITRATE. E. P. Alekseeva (Univ. of Irkutsk). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 545-7 (Apr. 1961). (In Russian)

The luminescence and the thermoluminescence of LiF crystals were investigated, using an x-ray tube with a W anode and a Be window for excitation. Spectrophotometric data showed that the maxima of the absorption bands shift toward the longer wavelengths when the concentration of the activator was increased. The data were similar to those obtained with CaF_2-U^{6+}; the luminescence of the phosphors activated by uranyl salts is assumed to be due to the radiation of the U ion transformed by the crystal lattice. At high concentrations of the activator (about 0.2%), a new band with a maximum at 5700 A is formed resulting in a violet coloration of the crystal. The spectral compostion of the thermoluminescence of pure LiF differs from the spectrum of the activator. A thermopeak has been observed at 110°C, the activator quenches the thermopeaks at 160 to 200°C which are quite strong in the pure crystals. While the ratio of thermopeaks is shifted under the influence of the activator, no new thermopeaks are formed by it. (TTT)

25318 LUMINESCENCE OF THE URANIUM-ACTIVATED LITHIUM AND SODIUM FLUORIDE MONOCRYSTALS. L. M. Belayev, G. F. Dobrzhanskii, and P. P. Feofilov. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 548-56(Apr. 1961). (In Russian)

The high intensity of the luminescence of LiF and NaF activated by U is used for determining the U concentration of LiF and NaF powders and melts. Use of monocrystals which have an NaCl-type cubic lattice, makes it possible to apply polarization methods. The U is introduced in the system in the form of UO_2 nitrate, sulfate or acetate, yielding ultimately U_3O_8 below the melting point of the pure crystal. During the tests the U concentration was varied from 0.01 to 0.5%. The absorption maxima of the NaF-U system were at about 555, 535, 480, 365, and 275 mμ; those of the LiF-U system were at about 520, 505, 405 (?), and 320 mμ. Upon cooling from room temperature to liquid N

temperature the bands were divided into numerous narrow lines. Luminescence has been noticed in both the visible and ultraviolet range, being changed again into a number of small lines at liquid N temperature with a width often below 1 A. The polarization spectra were found to be similar to the spectra of organic dyes. Study of the low-temperature polarization showed that U behaves like the rare-earth elements, being an electric and magnetic dipole emitter. The luminescence of the hexavalent U may be considered as the superposition of forced electric and magnetic transitions. A regular alternation of the sign of the polarization of the strongest luminescence line has been noted, attributing it to an alternation between electric and magnetic types of phenomena. (TTT)

25319 ELECTRICALLY IMPLODED-EXPLODED ALUMINUM TUBE. Eugene C. Cnare (Sandia Corp., Albuquerque, N. Mex.). J. Appl. Phys., 32: 1275-8(July 1961). (SCTM-347-59(51))

A high-energy exploding wire facility was used to investigate pinch effects in thin-walled aluminum tubing. The experiments carried out consisted of subjecting the tubing to the discharge of a 141-kj capacitor bank and observing its motion by flash radiography and by high-speed sequential photography. Each tube first imploded uniformly, then broke down into an arc discharge in a manner similar to that of solid exploding wires. The implosion or pinch phase is adequately accounted for by the magnetic forces of the current discharge first acting against the mechanical strength of the tube walls and then, after melting, against the wall inertia and the retarding force of the air being compressed within the tube. (auth)

25320 p-TYPE PHOTOCONDUCTIVITY AND INFRARED QUENCHING IN ELECTRON-BOMBARDED CdS. B. A. Kulp and R. H. Kelley (Aeronautical Research Lab., Wright-Patterson AFB, Ohio). J. Appl. Phys., 32: 1290-2 (July 1961).

A platelet-type crystal of pure cadmium sulfide 46 μ thick was irradiated first with 100-kev electrons to reduce the number of sulfur interstitials, then for 400 μamp-hr/cm^2 with 150-kev electrons to produce an excess of sulfur vacancies. At room temperature, photoconductive peaks were observed at 0.67, 0.9, and 1.4 μ. Point-contact rectification was used to determine that the 0.67-μ peak was due to electronic conduction and the 0.9- and 1.4-μ peaks were due to hole conductivity. A "quenching" experiment, i.e., simultaneous irradiation with bandgap light and infrared light of variable wavelength, at room temperature shows the 0.67-μ photopeak and quenching at 0.9 and 1.4 μ. In a separate experiment, the 1.4-μ quenching bank was partially removed from a platelet-type crystal by bombarding at 100 kev. This bombardment also removed edge emission from this crystal. The temperature dependence of the 1.4-μ quenching band and of the intensity of edge emission as observed by Reynolds suggests that the centers for edge emission and for the 1.4-μ quenching bands are actually the same center, namely the sulfur interstitial in different ionization states. (auth)

25321 PROPAGATION IN PERIODIC ELECTRON BEAMS. W. M. Mueller (Hughes Aircraft Co., Los Angeles). J. Appl. Phys., 32: 1349-60(July 1961).

A small-signal analysis of smooth electron beams with periodic variations in their d-c parameters reveals the existence of infinite sets of space harmonics of the fast and slow space-charge waves. For a finite beam coupling between the space-charge waves and field waves exists at an infinite number of frequencies. The periodicity of a beam has a very small effect on the space-charge wave propagation constants. Velocity-jump, rippled-stream, and rippled-wall amplification are shown to result from coupling between fast and slow space-charge waves of adjacent harmonics. The periodicity of an electron beam will have negligible effect on most conventional traveling-wave devices. Although the frequency dependence of the amplitudes of the beam harmonics may introduce difficulties in some devices, this dependency may also be made use of in a variety of ways. Beam harmonics make millimeter-wave interactions possible in smooth circuits, but practical devices at these frequencies will probably be limited to those employing positional periodicity of the beam. (auth)

25322 CHARGED CYLINDRICAL TUBE. T. R. Ferguson and R. H. Duncan (New Mexico State Univ., University Park). J. Appl. Phys., 32: 1385-7(July 1961).

The Fourier series for the charge density on a hollow tube of finite length is found in such a way that the Fourier coefficients are the unknowns of a system of linear equations. A machine method is used to solve the set of equations in finite order. The leading coefficient is the most accurately known at any order, and solely determines the capacitance of the tube. Capacitances are determined for various ratios of half-length to radius to an accuracy of better than 0.02%. The technique of solving the integral equation for charge density is useful in other physical problems. (auth)

25323 MULTIPLE SHOCK WAVE STRUCTURES IN POLYCRYSTALLINE FERROELECTRICS. C. E. Reynolds and G. E. Seay (Los Alamos Scientific Lab., N. Mex.). J. Appl. Phys., 32: 1401-2(July 1961).

Electrical measurements with piezoelectric shock detectors were made in three ferroelectric ceramics: Pb $(Zr_{0.52}, Ti_{0.48})O_3$ with 1 wt.% Nb_2O_5, pure $BaTiO_3$ and 5% $CaTiO_3$. The existence of two-wave structures and an interaction zone was confirmed. The velocity of the surface resulting from the first shock is time dependent and may be calculated; the free surface velocity from the second shock remains constant. (L.N.N.)

25324 ANALYSIS OF SPOT SIZE FORMATION IN BIPOTENTIAL ELECTRON GUNS. Aurelius Sandor (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). J. Electronics and Control, (1) 10: 245-60(Apr. 1961). (In English)

A semi-empirical method is worked out which permits prediction of the final spot size on the viewing screen of triode type electron guns with conventional grid aperture sizes of 0.025 to 0.035 in. diameter. By basing all relations on total beam current and standard grid aperture size, the deadlock encountered in more rigorous methods, requiring gun characteristics and current distribution in the beam, is eliminated. Spot enlarging factors, such as spherical aberration and space charge, are related to the paraxial imaging laws over empirical functions, enabling one to single out each of the three components before scalar synthesis. By acquiring insight into the essential size-contributing factors of a gun, a certain amount of optimization of constructional and operational nature can be also derived. Very good agreement with spot size measurements on conventional type guns is obtained, proving the general usefulness of the method in this complex matter. (auth)

25325 EQUILIBRIUM ELECTRON DISTRIBUTIONS IN ELECTRIC AND MAGNETIC FIELDS. N. Anderson (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Electronics and Control, (1) 10: 285-91(Apr. 1961). (In English)

Equilibrium distributions of electrons in electric and magnetic fields such that the distribution function only de-

pends on the invariants of the motion of the individual particles are considered. The motion is assumed to be collision-free. The electric and magnetic fields are then determined as functions of the parameters of the distribution function by a particularly simple form. The purpose of such a study is to try to obtain information about the reverse procedure, that is, constructing equilibrium distributions for a given field configuration. It seems, from the results obtained in the most simple case discussed, that the method used does not offer much promise of being able to decide the equilibrium distribution for a given field configuration, since the number of parameters in the solutions for the field is too large to see its behavior when the distribution function is varied. (auth)

25326 Kr^{86} AND ATOMIC-BEAM-EMITTED Hg^{198} WAVELENGTHS. R. L. Barger (National Bureau of Standards, Boulder, Colo.) and K. G. Kessler. J. Opt. Soc. Am., 51: 827-9(Aug. 1961).

Vacuum wavelengths are given for the Hg^{198} 2537- and 3132-A lines and the Kr^{86} 6013- and 5651-A lines referred to the Kr^{86} primary standard line 6057 A. The light sources were an Hg^{198} atomic-beam and a Kr^{86} hot-cathode lamp. A vacuum Fabry-Perot interferometer was employed for the measurements. The wavelength of the Hg^{198} 3132-A line was also determined by using the Hg^{198} 2537-A line as the reference standard. The accuracy of measurement of the Hg^{198} lines is about a factor of 5 higher than that of the Kr^{86} lines. (auth)

25327 SPECTROSCOPIC STUDIES OF IONIZATION IN A HOLLOW-CATHODE DISCHARGE. Kenneth B. Mitchell (Los Alamos Scientific Lab., N. Mex.). J. Opt. Soc. Am., 51: 846-53(Aug. 1961).

The influence of carrier gas, carrier gas pressure, cathode geometry, and discharge current on the ionization of metal atoms in a hollow-cathode discharge was studied in some detail. Most of these studies were made with an iron hollow-cathode discharge. A measure of ionization was obtained from the intensity ratio of a line of the second to a line of the first spectrum. In general, this ratio was found to increase with carrier gas pressure and discharge current. This ratio also increased with increasing cathode bore diameter but decreased with increasing bore length. This ratio for iron was greatly affected by the use of different inert carrier gases. Of the five common inert gases used, xenon produced the largest value for this ratio and argon produced the smallest. The results of these studies indicated this may be a new method for distinguishing between lines emitted by the neutral atom and lines of the singly ionized atom. (auth)

25328 COLLECTION AND SPUTTERING EXPERIMENTS WITH NOBLE GAS IONS. O. Almén and G. Bruce (Chalmers Univ. of Tech., Goteborg). Nuclear Instr. & Methods, 11: 257-78(May 1961). (In English)

Experimental work on the collection of noble gas ions of energies 5 to 65 kev is described. An electromagnetic isotope separator is used to measure saturation values in different materials. The dependence of saturation value on different experimental conditions is investigated, e.g., variations with current density, angle of ion beam incidence, and target temperature. In order to provide a simple description of the collection process, the sputtering ratios for noble gas ions bombarding different materials are also measured. (auth)

25329 SPUTTERING EXPERIMENTS IN THE HIGH ENERGY REGION. O. Almén and G. Bruce (Chalmers Univ. of Tech., Goteborg). Nuclear Instr. & Methods, 11: 279-89(May 1961). (In English)

Sputtering ratios for three target metals, Cu, Ag, and Ta, are determined for 45 kev ions of about 70 elements. A formula for estimation of the collected amounts of ions in a target material is given. From this the amounts collected in Ta are calculated and compared with experimental determinations. In addition, selfsputtering ratios are determined for about 25 elements at 45 kev ion energy, and for some of them also at lower energies. (auth)

25330 A 200 MICROAMPERE NEGATIVE ION SOURCE, UTILISING A SUPERSONIC MERCURY JET. Ralph H. V. M. Dawton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Instr. & Methods, 11: 326-30 (May 1961). (In English)

An account is given of a H^- ion source using a mercury supersonic jet type donor. The currents obtained are many times greater than those given by other sources, but there are disadvantages of this type of donor particularly when used with a vertical ion beam. Attention is drawn to these disadvantages. (auth)

25331 CURRENT-CHARGE DENSITY COMMUTATION RELATIONS. Kenneth Johnson (Massachusetts Inst. of Tech., Cambridge). Nuclear Phys., 25: 431-4(1961). (In English)

It is shown that the non-vanishing of the current–charge density commutator at equal times is required by and is compatible with the continuity equation. (auth)

25332 POSSIBILITY OF EXCHANGE MAGNETOSTRICTION YIELDING NEGATIVE THERMAL EXPANSION IN SOLID He^3. D. S. Rodbell (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev. Letters, 7: 1-3 (July 1, 1961).

The thermal expansion of solid He^3 is considered. It is shown that the existence in He^3 of high compressibility, antiferromagnetism, and an exchange interaction dependent upon the interatomic separation may give rise to a negative thermal expansion coefficient at low temperatures. (T.F.H.)

25333 SHOCK LAYER ELECTRON DENSITIES CONSIDERING THE EFFECTS OF BOTH CHEMICAL REACTIONS AND FLOW FIELD VARIATIONS. M. H. Bortner (General Electric Co., MSVD, Philadelphia). Planetary and Space Sci., 3: 99-103(1961).

A method for the calculation of the variation of electron density with time in a non-equilibrium shock layer of a re-entry vehicle is developed. The method includes the effects of changes in both temperature and density. The temperature and the density are each changed by both chemical reaction and the expansion of the gas in the flow field. These changes in turn affect the rate of the chemical reactions. Calculations on a simplified system of four reversible chemical reactions are made along given streamlines by an iterative method on a set of simultaneous equations for the rate of change of concentrations of the various species. An example is given for a calculation in which the electron density is far below the equilibrium value for a considerable time. (auth)

25334 THERMODYNAMIC RELAXATION OF ATMOSPHERIC GASES IN SHOCK WAVES. B. Steverding and L. Werner (Army Ballistic Missile Agency, Redstone Arsenal, Ala.). Planetary and Space Sci., 3: 113-17(1961).

The thermodynamic theory of relaxation is applied to shock waves. Soft shock waves, which are nearly adiabatic, show a simple exponential relaxation mechanism, which agrees with results obtained from the kinetic gas theory. For strong shock waves, deviations occur which increase as the disturbance of the thermal equilibrium increases. (auth)

25335 THE USE OF MODULATED ATOMIC-BEAM TECHNIQUES FOR THE STUDY OF SPACE-FLIGHT PROBLEMS. G. S. Holister, R. T. Brackmann, and W. L. Fite (General Atomic Div. of General Dynamics Corp., San Diego, Calif.). Planetary and Space Sci., 3: 162-8 (1961).

For investigations of atom-surface interactions, the use of beams of hydrogen and oxygen atoms is particularly appealing. However, a basic difficulty resides in tracing an atomic beam of number density of the order of 10^8 atoms/cm^3 through the residual gas of number density of the order of 10^{10} molecules/cm^3 (corresponding to a pressure of 2.5×10^{-7} mm Hg) in a laboratory vacuum system. This difficulty is overcome by modulating the atomic beam; in the present case, this is done by mechanically interrupting it at a frequency of 100 c/s. Under these conditions, any effect arising from the beam may be identified by its occuring at the modulation frequency and in a specified phase. Using this modulation technique, it becomes possible to use mass-spectrometric detection of the beam, since the electron-impact ionization cross-sections for hydrogen and oxygen atoms are known. Results of a number of experiments using these techniques are presented. (auth)

25336 MOLECULAR STUDIES WITH A LOZIER ELECTRON IMPACT APPARATUS. M. A. Fineman and A. W. Petrocelli (Providence College, R. I.). Planetary and Space Sci., 3: 187-93(1961).

The potentialities of the Lozier electron impact apparatus for studying simple molecules are given. The properties which may be determined with this instrument are listed. Following a presentation of the various processes occurring on low energy electron bombardment, the manner of measuring a property related to the molecule is outlined by considering a polar dissociation process. The construction and operation of the Lozier apparatus are briefly described. Finally the results of the study of CO with this instrument are presented to demonstrate the utility of this technique of investigation. (auth)

25337 THE PRESENT STATUS OF INTERMOLECULAR POTENTIALS FOR CALCULATIONS OF TRANSPORT PROPERTIES. R. A. Buckingham (Univ. of London). Planetary and Space Sci., 3: 205-16(1961).

A review is given of the present state of knowledge of the interaction of systems having spherical symmetry, with special reference to the adequacy of analytic expressions used to represent such interactions, and to methods of deriving short range repulsive potentials. Some recent calculations of transport coefficients for "dissociated" atoms are briefly described. A bibliography of recent contributions to the subject is included. (auth)

25338 INTERMOLECULAR POTENTIALS FOR IONIC SYSTEMS. A. Dalgarno (Geophysics Corp. of America, Boston). Planetary and Space Sci., 3: 217-20(1961).

A review is given of the present state of knowledge of the interaction potentials between ionic and atomic systems. (auth)

25339 HIGH TEMPERATURE GASEOUS DIFFUSION EXPERIMENTS AND INTERMOLECULAR POTENTIAL ENERGY FUNCTIONS. R. E. Walker, L. Monchick, A. A. Westenberg, and S. Favin (Johns Hopkins Univ., Silver Spring, Md.). Planetary and Space Sci., 3: 221-7(1961).

A discussion is presented of binary diffusion data over the temperature range 300 to 1150°K for the gas pairs: He–N_2, CO_2–N_2, He–Ar, CO_2–O_2, CH_4–O_2, H_2–O_2, CO–O_2, and H_2O–O_2. The data cover a wide enough range in temperature and are of sufficient precision (~±2%) so that it is possible to examine them in terms of the kinetic theory of dilute gases and the intermolecular potential energy functions characterizing binary collision processes. The three functions used for which the necessary collision integrals are evaluated are the inverse power point center of repulsion potential, the Lennard-Jones (12-6) potential, and the modified Buckingham (Exp-6) potential. In addition, the collision integrals for the exponential point center of repulsion potential were evaluated by numerical means. The high temperature diffusion coefficients predicted from the four potentials fitted at lower temperatures agree rather well. (auth)

25340 TRANSPORT PROPERTIES OF ATOMIC HYDROGEN. A. Dalgarno (Geophysics Corp. of America, Boston). Planetary and Space Sci., 3: 236-7(1961).

The effects of quantal symmetry requirements on the collision of two similar particles are discussed and it is pointed out that anomalously large values will occur for the cross section effective in diffusion but not for the cross section effective in viscosity and thermal conductivity. Quantitative data are reported for the diffusion cross sections associated with collisions of protons, neutral hydrogen atoms and negative hydrogen ions respectively with neutral hydrogen atoms at high temperatures. (auth)

25341 THERMODYNAMIC EFFECTS OF COULOMBIC INTERACTIONS IN IONIZED GASES. H. Myers (Douglas Aircraft Co., Santa Monica, Calif.), J. H. Buss, and S. W. Benson. Planetary and Space Sci., 3: 257-70(1961).

The deviations from ideality arising from the electrostatic interactions between charged particles in a plasma are studied by an adaption of the Debye-Hückel theory. The results of the study for represenative systems are presented. The significant finding is that the composition of equilibrium mixtures shows large deviations from that calculated from ideal gas theory. At sufficiently high ion densities these deviations are large enough to alter the thermodynamic functions of the plasma. (auth)

25342 EXPERIMENTAL INVESTIGATIONS OF PLASMA ACCELERATORS FOR SPACE VEHICLE GUIDANCE AND PROPULSION. B. Gorowitz, K. Moses, and P. Gloersen (General Electric Co. Missile and Space Vehicle Dept. Philadelphia). Planetary Space Sci., 4: 102-10(1961).

A description is given of experimental studies concerning the possible application of a plasma accelerating device as a small thrust electric drive for space propulsion and attitude control. The particular laboratory model discussed employs a capacitor discharge across the gap between two electrodes to create a highly ionized but electrically neutral plasma which is electromagnetically accelerated into a chamber in which an attempt is made to simulate the pressure conditions of outer space. A novel valve is devised which serves the dual purpose of introducing the minute amounts of propellant required while obviating the need for external switching of the discharge. As a result of this development, a considerable improvement in the efficiency of energy conversion of earlier models is affected. Specific impulses obtained with the T-tube accelerator are in the range of 1000 to 20,000 sec, with calculated efficiency of conversion of stored electrical energy to mechanical energy as high as 60 per cent. Although the measurements discussed are of a preliminary nature, it is believed that they clearly demonstrate that more detailed and advanced research into plasma acceleration problems is fully justified. (auth)

25343 THERMODYNAMIC PERFORMANCE STUDY OF POSSIBLE WORKING FLUIDS FOR NON-CHEMICAL ROCKETS. Kenneth E. Kissell (Aeronautical Research Lab., Wright Air Development Center, Wright-Patterson AFB, Ohio). Planetary Space Sci., 4: 111-32(1961).

A thermodynamic analysis is made to compare three possible working fluids, hydrogen, air, and water, for engines deriving their power from electrical or nuclear sources, thus permitting heating to extreme temperatures. High exhaust velocities are shown to be attainable despite the possible losses to be incurred by ionization and dissociation of the working fluid. The physical size of the non-chemical engine is shown to be comparable to that of chemical rockets if one excludes the energy source. The actual nozzle dimensions are shown to depend upon the nature of equilibrium process within the nozzle. The power requirements for non-chemical rockets are shown to exceed the output of all but the largest stationary generators and reactors operating today. (auth)

25344 ELECTROMAGNETIC ACCELERATION OF PLASMA FOR SPACE PROPULSION. A. Schock (Republic Aviation Corp., Farmingdale, N. Y.). Planetary Space Sci., 4: 133-44(1961).

Four methods are described for analyzing the dynamic behavior of plasma accelerators: the gasdynamic, the snowplow, the free-particle, and the slug model. The latter method is examined in detail, and it is demonstrated that approximate solutions exist which aid in predicting the effect of various parameters on performance. It is concluded that the use of this analytical model in designing the system and the mode of operation can lead to favorable efficiencies in converting electrical to kinetic energy. (auth)

25345 SATELLITE AUXILIARY POWER SYSTEMS. Nels B. Palmquist, Jr. (Lockheed Aircraft Corp., Sunnyvale, Calif.). Planetary Space Sci., 4: 202-24(1961).

The general requirements of auxiliary power systems for satellites are presented, in particular for the recent Discoverer II vehicle. The preliminary studies, design approaches, and hardware development of the prime energy equipment and power conversion equipment are discussed. Pictures showing the mechanical configurations and curves illustrating performance characteristics of the equipment are included. The auxiliary power system is formulated, and its flight performance is evaluated. A brief look at future systems such as solar photovoltaic, nuclear, thermoelectric, and high energy batteries is also presented. The ultimate goal of the auxiliary power system is not to be the limiting factor in the useful life of the satellite vehicles. (auth)

25346 PERFORMANCE DATA AND ENVIROMENTAL TEST RESULTS OF SNAP III. Fred N. Huffman and Louis W. Gross. Planetary Space Sci., 4: 226-41(1961).

Performance data and environmental test results on the polonium-fueled SNAP III thermoelectric generator for satellite power are described. Although one may squeeze five watts out of the generator in room ambient conditions, it is a 2.5 w unit in a space environment. The electrical performance data and the vibration, acceleration, and shock results indicate the feasibility of using the generator for extending the useful life of satellites. Curves are given of its performance along with a description of the generator. (N.W.R.)

25347 DIFFUSION EFFECTS ON SHOCK STRUCTURE IN A PLASMA. Hari K. Sen (Air Force Cambridge Research Center, Bedford, Mass.), Oscar W. Greenberg, and Yvain M. Trève. Planetary Space Sci., 4: 358-73(1961).

A study of diffusive charge separation effects on the shock structure in a totally ionized hydrogen plasma was made using alternatively a simplified form of the Navier-Stokes equations and a simple kinetic theory model. The proton and electron densities and the electric field have an oscillatory fine structure, of the order of the Mach number, M, times the Debye length, λ_D, and overshoot their final Rankine-Hugoniot values. These oscillations decay exponentially with a relaxation distance proportional to the mean free path. The peak ratio of the electric field energy to the plasma thermal energy is appreciable, and increases rapidly with M. (auth)

25348 THE EFFECTS OF ELECTRODE CONTAMINATION ON THE PROPERTIES OF AIR-ARC PLASMAS. Harold Y. Wachman, Minton J. Linevsky, and John H. McGinn. Planetary Space Sci., 4: 374-81(1961).

The plasma test environments originating from arcs are usually contaminated with material from the arc electrodes. Carbon electrodes contribute appreciable quantities of vapor which alter the chemical composition and thermodynamic properties of the jet and cooled copper electrodes contribute trace quantities of vapor which, as expected, alter the character of the electrical discharge. In this work, the chemical composition and thermodynamic properties of air are compared to those of air–carbon gaseous mixtures containing 1 to 30% carbon by weight. The comparison of the different environments is made from 4000 to 10000°K 0.1 to 100 atm. The effects of trace amounts of copper on the electrical conductivity and power dissipated in the air column are calculated. (auth)

25349 MgH AND MgD BANDS AT 2819 Å AND 2702 Å. M. Aslam Khan (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 77: 1133-40(June 1, 1961).

Spectral bands in MgH at 2819 and 2702 Å, and the corresponding band in MgD at 2816 Å, are observed and analyzed. The transitions giving rise to these bands are classified. (auth)

25350 COLLECTIVE MODES IN THE THEORY OF SUPERCONDUCTIVITY. D. J. Thouless and D. R. Tilley (Univ. of Birmingham, Eng.). Proc. Phys. Soc. (London), 77: 1175-81(June 1, 1961).

Some results derived by use of finite temperature perturbation theory are used to investigate the possibility of a low-energy collective mode in a superconductor. It is found that such a mode should exist, and the ratio of its energy to its momentum is calculated. This ratio approaches infinity exponentially as the temperature goes to zero, in agreement with the prediction that at zero temperature the collective mode is destroyed by the Coulomb force. The effect of this collective mode on the specific heat is negligible. The relation of the mode to second sound is discussed. A comparison is made between the behavior of this collective mode in a charged superfluid system (superconductor) and the behavior of the collective modes in a superfluid system of neutral fermions. (auth)

25351 PROPERTIES OF VAVILOV-CHERENKOV EFFECT IN ANISOTROPIC WAVE GUIDES. N. A. Khizhnyak and V. P. Shestopalov. Trudy Radiofiz. Fak. Khar'kov. Gosudarst. Univ. im. A. M. Gor'kogo, 3: 69-74 (1959). (In Russian)

Characteristics of the Vavilov-Cherenkov effect are studied with a charged particle moving uniformly along the axis of a rectangular waveguide filled with anisotropic dielectric with a diagonal permittivity tensor. (R.V.J.)

5352 PARAMETRIC EXCITATION OF OSCILLATIONS IN ELECTRON BEAMS. N. A. Khizhnyak. Trudy Radiofiz. Fak. Khar'kov. Gosudarst. Univ. im. A. M. Gor'kogo, 3: 75-9(1959). (In Russian)

Interactions of uniformly moving electron beams with slow electromagnetic waves in cylindrical waveguides carrying a dielectric with periodically varying dielectric density $\epsilon = \epsilon(z)$ were studied in order to determine the Cherenkov instability. (R.V.J.)

5353 THE POTENTIAL MODEL TREATMENT OF THE SCATTERING OF ELECTRONS BY ATOMS AND THE EXISTENCE OF NEGATIVE IONS. F. B. Malik and E. Trefftz (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Naturforsch., 16a: 492-500(May 1961). (In English)

The low energy scattering of electrons by different neutral atoms has been treated by assuming that the atomic wave functions remain unchanged even in the presence of the scattered particle and by neglecting the exchange between the scattered electron and the bound electrons. The potential term in the differential equation of the scattered particle is exactly the atomic potential of the neutral atom and is approximated by analytical expressions, yielding the potential scattering equation. The variational treatments of Hulthén, Kohn and a related one suggested by Malik, are applied to solve this equation for a Hartree atom with $l = 0$. The scattering of He, C, and N is treated explicitly, and the results for He indicate that in this way one may get some good results without going into the great complexity of the many body problem. It is further pointed out that the study of scattering by neutral atoms near zero energy under this model may serve as a possible means to investigate the existence of different negative ions and their number of bound states. It seems from this point of view that He^-, C^-, and N^- for this model may exist and have one bound s-state. (auth)

5354 ELASTIC SCATTERING OF LOW ENERGY POSITRONS BY ATOMS. F. B. Malik (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Naturforsch., 16a: 500-5(May 1961). (In English)

Elastic scattering cross sections of low energy positrons (up to about 40 ev) by helium, carbon, nitrogen, oxygen, fluorine, neon, and argon atoms are calculated by variational methods. The scattering potentials are taken to be the analytical approximations of different Hartree potentials. Only s-wave is included. Comparisons with the available experimental data of positron scattering by He, Ne, and Ar reveal that either a considerable strong polarization potential will be required to bring the theoretical results on par with experiments or the formation of virtual positronium plays a dominant role for this kind of elastic scattering. (auth)

5355 FUNDAMENTOS TEÓRICOS DE LA FÍSICA ATOMICA Y NUCLEAR. (Fundamental Theories of Atomic and Nuclear Physics). C. Sánchez Del Río. Madrid, Servicio de Publicaciones de la J. E. N., 1960. 175p. 75 pesetas.

A qualitative introduction to the theory of the atom, its nucleus, and the elementary particles is given. The book is intended for the non-specialist in physics and for the student of theoretical physics as a conceptual introduction to the refined theories. (J.S.R.)

5356 PHYSICAL GAS DYNAMICS. A. S. Predvoditelev, ed. Translated from the Russian by R. C. Murray and A. R. H. Phillips. New York, Pergamon Press, 1961. 336p.

The thermodynamic and gas-dynamic properties of gases are studied. Various types of shock waves in gases (especially air) and water are examined. The thermodynamic properties of air at 1000 to 12000°K and 0.001 to 1000 atm are tabulated. Calculations of the kinetic and transfer coefficients of multicomponent gases are considered. Gas flow in the vicinity of a normal shock wave is studied. Shocks in water caused by electric discharges and compression waves are investigated. Shocks in gases caused by flame fronts are examined. Gas flow from an obliquely cut nozzle, and supersonic gas flow around a finite edge are studied. (T.F.H.)

Astrophysics and Cosmology

25357 (BNL-658) RADIOASTRONOMY AND COMMUNICATION THROUGH SPACE. Brookhaven Lecture Series Number 1. Edward Purcell (Harvard Univ., Boston and Brookhaven National Lab., Upton, N. Y.). Nov. 16, 1960. 13p.

The lecture contains discussions on developments in radioastronomy, requirements for space travel to a place 12 light years away, and speculations for communicating through space. (B.O.G.)

25358 (NASA-TN-D-681) RADIATION SHIELDING FOR MANNED SPACE FLIGHT. Lewis E. Wallner and Harold R. Kaufman (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). July 1961. 45p.

Cosmic radiation, solar flares, the earth's Van Allen belts, and nuclear radiation are assessed. For the Mars mission, cosmic and solar-flare radiations may require biological-shield weights of 100,000 lb. Shield needs for the nuclear reactor and the Van Allen belts are an order of magnitude less than this except for slow traversal of the earth's radiation belts. Much weight can be saved if a common mass can be utilized against all radiation hazards. For early space experiments, major solar flares probably constitute the prime radiation hazard. A partial body shield may possibly be designed with adequate radiation protection for 100 lb per man. (auth)

25359 (AEC-tr-3973(Pt.I)(p.169-78)) THE SILICON SOLAR BATTERY AS A POWER SOURCE IN ARTIFICIAL EARTH SATELLITES. V. S. Vavilov, V. M. Makovetskaya, G. N. Galkin, and A. P. Landsman. Translated from Uspekhi Fiz. Nauk, 63: 123-9(Sept.-Oct. 1957).

Discussions are included of the principles of the action of a semiconductor convertor with a p-n junction, the load I-V characteristics of an experimental silicon photoelement, and the conditions of temperature of a solar battery. (B.O.G.)

25360 (AEC-tr-3973(Pt.I)(p.305-20)) INVESTIGATION OF THE IONIC COMPOSITION OF THE IONIZED LAYERS OF THE ATMOSPHERE. B. A. Mirtov and V. G. Istomin. Translated from Uspekhi Fiz. Nauk, 63: 227-38(Sept.-Oct. 1957).

The discussion is given in terms of the role of the satellite in the investigation of the spectra of ions in the ionosphere, general and specific problems encountered in the performance of the experiments, instruments for the direct study of the ionic composition of the upper atmosphere, and the Bennett-type radio-frequency mass spectrometer. (B.O.G.)

25361 (AEC-tr-3973(Pt.I)(p.321-39)) MEASUREMENT OF THE POSITIVE ION CONCENTRATION ALONG THE ORBIT OF ARTIFICIAL EARTH SATELLITES. K. I. Gringauz and M. Kh. Zelikman. Translated from Uspekhi Fiz. Nauk, 63: 239-52(Sept.-Oct. 1957).

A review is presented of the measurements in which discussions are given of the comparative advantages of using rockets and satellites, properties of the ionosphere at various altitudes, the distribution of charged particles in the vicinity of the satellite, the potential of the conductive surface of the body of the satellite, the principles of the measurements, the experimental setup, and the effects which distort the measurements. (B.O.G.)

25362 (AEC-tr-3973(Pt.I)(p.340-55)) INVESTIGATION OF THE SOLID COMPONENT OF INTERPLANETARY MATTER BY MEANS OF ROCKETS AND SATELLITES. S. M. Poloskov and T. N. Nazarova. Translated from Uspekhi Fiz. Nauk, 63: 253-65(Sept.-Oct. 1957).

A review is given of studies of the role of meteoric particles in physical processes in the atmosphere. Methods are described for the determination of the flux and the kinetic energy of the particles. (B.O.G.)

25363 (AEC-tr-3973(Pt.I)(p.356-78)) MEASUREMENT OF ELECTROSTATIC FIELDS IN THE UPPER LAYERS OF THE EARTH'S ATMOSPHERE. I. M. Imyanitov. Translated from Uspekhi Fiz. Nauk, 63: 267-82(Sept.-Oct. 1957).

A review is given concerning previous studies of electrostatic fields existing in the upper layers of the earth's atmosphere. Considerations are included of ways of measuring the electrostatic fields and the design of the instruments suitable for the measurements. (B.O.G.)

25364 (NP-tr-682) IONIZATION IN THE EARTH'S IONOSPHERE, AND THE ENERGY OF SHORTWAVE SOLAR UV RADIATION. G. S. Ivanov-Kholodnyi (Ivanov-Kholodnyy). Translated from Doklady Akad. Nauk S.S.S.R., 137: 327-30(1961). 8p.

Examinations were made of the results of investigations on the ionization processes in the upper atmosphere and shortwave solar radiations. It was concluded that the basic process of neutralization in the ionosphere is the dissociative recombination of molecular ions. The total number of recombination and ionization processes in an atmospheric column of 1 cm^2 cross section is 3×10^{11} to 3×10^{13} cm^{-2} sec^{-1}. The new concepts of the basic processes in the ionosphere agree with recent data on shortwave solar radiation, which contains 5 to 10×10^{11} quanta/cm^2/sec for spectral regions λ = 800A. (B.O.G.)

25365 NEUTRINO EMISSION PROCESSES, STELLAR EVOLUTION AND SUPERNOVAE. PART I. H. Y. Chiu (Inst. for Advanced Study, Princeton, N. J.). Ann. Phys. (N. Y.), 15: 1-21(July 1961).

A general qualitative discussion of evolution of stars of masses <1.4 M is presented. The role of gravitational contraction is emphasized with respect to element synthesis. It is found that most of the stars with masses above a few tenths solar mass will proceed through all phases of element synthesis and consequently will become a supernova. The URCA process suggested by Gamow and Schönberg in 1941 will change this picture. During the α-process of element synthesis the rate of gravitational energy release is of the same order as that lost due to URCA neutrinos, and the critical mass for supernova is not certain, although the upper limit is less than the Chandrasekhar mass limit for degenerate gas spheres. The URCA process energy dissipation rates of a number of elements are calculated for $T = 6 \times 10^8$, 1.2×10^9, 2.4×10^9, and 6×10^9 °K, respectively. (auth)

25366 FLUX AND ENERGY SPECTRA OF THE PROTONS IN THE INNER VAN ALLEN BELT. J. E. Naugle and D. A. Kniffen (National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.). Phys. Rev. Letters, 7: 3-6(July 1, 1961).

The fluxes and energy spectra of protons in the inner Van Allen belt are measured as functions of positions in the belt. Emulsion data are analyzed from a rocket flown to a height of about 2000 km, at latitudes between 15 and 35°N. The data are studied for protons with energies from 8 to 100 Mev, at altitudes above 1600 km. (T.F.H.)

25367 RELATIONS BETWEEN PLASMA PHYSICS AND ASTROPHYSICS. COMMENT ABOUT COMET TAILS. Walter F. Huebner (Los Alamos Scientific Lab., N. Mex.). Revs. Modern Phys., 33: 498(July 1961).

Some speculations are given regarding a possible mechanism for the production of comet tails by ionization of the molecules CO and N_2 by charge exchange with solar protons. (L.T.W.)

25368 EXTINCT RADIOACTIVITY AND THE PREHISTORY OF THE SOLAR SYSTEM. Edward Anders (Univ. of Chicago). Z. Naturforsch., 16a: 520-1(May 1961). (In English)

Some of the implications of the discovery of Ag^{107} from the decay of Pd^{107} in the Toluca iron meteorite are discussed. The discrepancies in the predicted and observed abundances of extinct radioisotopes at various times Δt after the isolation of the solar system are reviewed on the basis of Ag^{107} in Toluca. Processes that will produce Pd^{107} in preference to longer-lived radioisotopes such as spallation or neutron capture at low fluxes are discussed, and experimental verification is suggested. (J.S.R.)

Cosmic Radiation

25369 (AD-254143) THE DISTRIBUTION OF ELECTRONS IN THE UPPER IONOSPHERE FROM BACKSCATTER OBSERVATIONS. Supplement I. J. V. Evans (Massachusetts Inst. of Tech., Lexington. Lincoln Lab.). Apr. 3, 1961. Contract AF19(604)-7400. 10p.

A re-examination of the experimental procedure and reduction methods used in deriving electron density profiles from backscatter observations revealed a small systematic error in the 6% overestimation of the noise level on the time base. Corrected profiles are presented; the correction is negligible below ~450 km height. A comparison is given of the results with an antenna elevation of 15° and with the antenna pointing at the zenith. The normalized electron density distribution for the region above the F2 peak is in better agreement with that of Kazantsev than previously. The results indicate that diffusion controls the electron densities above 360 km height. (D.L.C.)

25370 (NP-10459) THREE COSMIC RAY PROBLEMS: (1) DIFFUSION AND FRAGMENTATION, (2) INJECTION BY A SOLAR MAGNETIC ARCH, (3) COSMOLOGICAL EFFECTS OF EXTRAGALACTIC COSMIC RAYS. David B. Chang (California Inst. of Tech., Pasadena and Boeing Scientific Research Labs., Seattle). Dec. 1960. 108p. (D1-82-0022)

Preliminary investigations of three cosmic ray problems were made. The diffusion and fragmentation of the cosmic rays traversing the interstellar medium is treated with respect to the possibility of using the cosmic ray composition to test models of cosmic ray origin. Processes involved in, and conditions required for, an efficient acceleration mechanism operating in a solar magnetic arch are examined. The possibility of detecting extragalactic cosmic rays by observing their cosmological effects is discussed. (D.L.C.)

25371 (AEC-tr-3973(Pt.I)(p.179-99)) THE INVESTIGATION OF THE COMPOSITION OF PRIMARY COSMIC RADIATION. S. N. Vernov, V. L. Ginzburg, L. V. Kurnosova, L. A. Razorenov, and M. I. Fradkin. Translated from Uspekhi Fiz. Nauk, 63: 131-48(Sept.-Oct. 1957).

Discussions are given of experimental data on the composition of primary cosmic radiation, and experimental methods of investigating the nuclear-charge spectrum in primary cosmic radiation. Tabulated data are included for flux values of α-particles and nuclei in primary cosmic radiation. The relative abundances of Li, Be, and B nuclei in the primary flux of cosmic radiation are tabulated. (B.O.G.)

25372 (AEC-tr-3973(Pt.I)(p.200-17)) STUDIES OF COSMIC RADIATION VARIATIONS. S. N. Vernov, Yu. (Iu.) I. Logache, A. E. Chudakov, and Yu. G. Shafer. Translated from Uspekhi Fiz. Nauk, 63: 149-62(Sept.-Oct. 1957).

An examination was made of the feasibility of using an artificial earth satellite to study the variations in the intensity of cosmic radiation. The discussion is given in terms of instrumentation which may be used to study the following: variations in the intensity of primary cosmic radiation; variations in the multicharge component of primary cosmic radiation, consisting of nuclei of helium and heavier elements; the geomagnetic field at great distances from the earth; the albedo of the earth for cosmic radiation; and the structure of the particle streams emitted by the sun. (B.O.G.)

25373 (AEC-tr-3973(Pt.I)(p.218-42)) INVESTIGATIONS OF SHORT-WAVE ULTRAVIOLET SOLAR RADIATION. S. L. Mandel'shtam and A. I. Efremov. Translated from Uspekhi Fiz. Nauk, 63: 163-80(Sept.-Oct. 1957).

A review is presented of experimental and theoretical work on the study of short-wave solar radiations published since 1952. Experiments are described, which are expected to be performed with the help of satellites. (B.O.G.)

25374 ON THE NATURE OF THE EARTH'S THIRD RADIATION BELT. I. S. Shklovskii, V. I. Moroz, and V. G. Kurt. Astron. Zhur., 37: 931-4(1960).

Results obtained with the aid of ion traps set up on Soviet cosmic rockets indicate the presence of a third (outermost) radiation belt. This belt consists largely of relatively soft electrons with energies greater than 200 ev. In the region of the so-called second radiation belt and up to altitudes of about 50,000 km the flux of electrons with energies greater than 200 ev is less than 2×10^7 cm^{-2} sec^{-1}. On the other hand, in the region $55{,}000 < R < 75{,}000$ km the flux is about 2×10^8 cm^{-2} sec^{-1}. Thus the second belt should consist mainly of electrons having relatively high energies, and these electrons should move in the magnetic trap. It is argued that the third radiation belt is formed as a result of the interaction of solar wind and the earth's magnetic field. This leads to a redistribution of the energy, resulting in a net transfer from the protons to the electrons. The third radiation belt is a formation characteristic of magnetically quiet periods, when solar activity is low. It may be expected that during periods of high solar activity, when intense corpuscular streams reach the earth's atmosphere, both the third and second belts will be deformed, and their characteristics will be strongly affected. The energy density of the earth's magnetic field is consistent with the measured value of the charged-particle flux. It is argued that the concentration of stationary interplanetary plasma does not exceed the corpuscular concentration of the solar wind, about 1 cm^{-3}. (OTS)

25375 THE NATURE OF THE GAMMA EMISSION OF SOLAR FLARES AND THE FORMATION OF COSMIC PARTICLES IN ACTIVE SOLAR REGIONS. I. M. Gordon. Astron. Zhur., 37: 934-7(1960).

Balloon observations over Cuba were carried out during a chromospheric flare of class II. A short flare of γ rays was detected with the energy 5×10^5 ev and the duration 18 sec. The γ radiation was identified with bremsstrahlung radiation due to electrons with energies of the order of 1 Mev. The number of such electrons would have to be about 2.4×10^{34} and should originate in the solar photosphere. This interpretation meets with serious difficulties. The present argument is that two-photon positron-electron annihilation is responsible for the γ radiation. The necessary density of the part of the solar atmosphere in which this process takes place can be shown to be 5×10^{-11} g/cm^3 or $n = 3 \times 10^{13}$ cm^{-3}. This density corresponds to the lower layers of the chromosphere. It is also necessary at this density that the positrons should be decelerated before they take part in this annihilation process. If not, the γ spectrum would extend far into the short-wave region. Calculations show that the time necessary for the positrons to be retarded to an energy of 0.1 mc^2 is much smaller than 0.1 sec. Thus, the positrons are in fact able to lose most of their energy prior to annihilation so that the energy of the photons produced in the annihilation is of the order of the rest mass of the electron. Assuming that the total energy emitted in the form of γ rays during the flare was 3.8×10^{24} ergs, it can be shown that the number of positrons necessary is 2.4×10^{30}. If the total area of the flare was 1.5×10^{20} and the thickness of the region was 10^8 cm, then the necessary concentration of positrons is found to be 100 cm^{-3}. If the annihilation hypothesis is correct, then the observed radiation should have an intensity discontinuity at 5×10^5 ev. (OTS)

25376 POLAR IONOSPHERIC DISTURBANCES AND SOLAR CORPUSCULAR EMISSIONS. T. Obayashi and Y. Hakura (Radio Research Labs., Tokyo). Planetary Space Sci., 5: 59-60(1961).

Polar radio blackouts are classified into two characteristic types, one is the polar cap blackout and the other is the auroral zone blackout. It is shown that the polar cap blackout appears with some hours delay after a major solar radio outburst of type IV, and the blackout is confined within the geomagnetic latitude 60–65°. The estimated energies of particles causing this are of about 10 to 100 Mev. The auroral zone blackout then follows, being accompanied with geomagnetic storms and aurorae, and it may be caused by the so-called auroral particles of 1 Mev or less. The energy spectrum of solar particles associated with solar flares is revealed from the present result together with all information from various observations related to solar and terrestrial disturbances. It is concluded that solar particles have a conspicuous suprathermal non-Maxwellian tail extending from a few kev up to relativistic energy range, though the bulk of corpuscular clouds consists of rather low energy particles and hence likely to be in the Maxwellian distribution. Some discussions on the nature of solar corpuscular clouds and their effect upon the terrestrial ionosphere are also given. (auth)

Criticality Studies

25377 (NAA-SR-Memo-6414) NUCLEAR SAFETY IN HANDLING 10 PER CENT U^{235}-ENRICHED UO_2 FUEL. Norman Ketzlach (Atomics International. Div. of North

American Aviation, Inc., Canoga Park, Calif.). May 16, 1961. 4p.

Criteria were established for the safe fabrication and storage of 9.87% U^{235} enriched UO_2 fuel rods. Due to the limited amount of fuel to be handled in this project, safe criteria were based on fuel rods at optimum rod size and lattice spacing and water flooding. When the fuel is handled in pellet form, 530 g contained U^{235} is the maximum safe batch size independent of container size. The maximum safe volume, independent of mass, is 6.5 liters. When handled as 0.30-inch diameter finished fuel rods, it is safe to handle 26 rods (920 g contained U^{235}). A two-dimensional infinite array of fuel elements (24-rod bundles) is safe with a minimum edge-to-edge separation of 24 inches. This same spacing between safe batches of pellets is also safe. Fifty columns (2.75 inches by 2.75 inches cross section) of fuel elements are safe with a minimum edge-to-edge spacing of 12 inches. (auth)

25378 (NAA-SR-Memo-6415) NUCLEAR SAFETY CRITERIA IN USE OF RMDF TRANSFER CASK. Norman Ketzlach (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 16, 1961. 6p.

Criteria were established for the storage and transportation of a maximum of one kg contained U^{235} scrap in each 55-gal drum. These drums are stored four drums per pallet in a square lattice array. An array of such pallets, two pallets wide by two pallets high by six pallets long containing a total of 96 drums, is safe independent of the degree of water flooding. Two kg contained U^{235} is allowable per drum in a 180-drum, single-plane array. These arrays may be repeated with an edge-to-edge separation of at least 6 ft. (auth)

25379 (NAA-SR-Memo-6479) NUCLEAR SAFETY OF HALLAM FUEL STORAGE FACILITY. Norman Ketzlach (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 5, 1961. 8p.

Several criteria are presented showing that the present Hallam Fuel Storage Facility is safe for the storage of 3.6% U^{235} enriched U–10% Mo fuel and of 4.9% U^{235} enriched UC fuel. It is pointed out that better analytic methods must be developed for evaluating the safety of fuels of low U^{235} enrichment. (D.L.C.)

Elementary Particles and Radiations

25380 (CEA-1873) METHODES DIAGRAMMATIQUES EN MECHANIQUE STATISTIQUE QUANTIQUE. APPLICATION AUX SYSTEMS INFINIS DE FERMIONS A L'EQUILIBRE ET A BASSE TEMPERATURE. (Diagrammatic Methods in Statistical Quantum Mechanics. Application to Infinite Systems of Fermions in Equilibrium at Low Temperature). Cyrano de Dominicis (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 277p.

The grand partition function Z (α,β) of a quantum system is studied, using diagrammatic representations of the perturbation expansion. For a fermion system, it is possible to show, by proper resummations, without approximations but under some "regularity hypothesis," that Log Z (α,β) takes a form where, besides trivial dependences, α and β only appear through a statistical factor, $F_k^- = [1 + \exp(-\alpha + \beta\epsilon_k^0 + \beta W_k)]^{-1}$; W_k is a (real self-consistent potential, generalized to all orders and can be defined by a stationarity condition to Log $Z(\alpha,\beta)$, under variations of F_k^-. The thermodynamical quantities take a form analogous to the expressions Landau introduced for the Fermi liquids. The zero temperature limit (for isotropic systems) gives back Goldstone expressions for the ground state of a system. (auth)

25381 (JINR-D-695) RADIATIVE CORRECTIONS IN PION DECAYS. Ya. Smorodinskii (Smorodinsky) and Shih-ko Hu (Hu Shih-ko) (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. for Theoretical Physics). 1961. 8p.

Radiative effects on pion decays are calculated. The spectra of real photons emitted in the π-μ and π-e decays are different in form. The ratio of decay probabilities at a given value of the cutoff of the photon spectrum in both channels depends essentially upon the cutoff value. The radiative effects are found to contribute 3.93% to the total probability of radiative decay. The principal contribution to the radiative effects comes from the difference between the probabilities of photon emission by electrons and μ mesons. Formulas are found for the lepton and photon spectra in pion decays. (auth)

25382 (JINR-D-701) SPIN DEPENDENCE OF WEAK INTERACTION IN THE PROCESS $\mu^- + p \rightarrow n + \nu$. A. E. Ignatenko, A. B. Kuptsov, Suang-ming Li, M. G. Petrasku, L. B. Yegorov, and G. V. Zhuravlev (Joint Inst. for Nuclear Reaearch, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1961. 14p.

Using the scintillation counter method, measurements were made of the values, average with respect to two states of hyperfine structure, of the $\bar{a}_0$ assymetry coefficients of $(\mu \rightarrow e)$-decay electrons in mesic atoms of silver and red and black phosphorus. The lifetimes τ of mesons in these modifications of phosphorus were also determined. The quantities of $\bar{a}_0$ for red and black phosphorus indicated that the time of the relaxation of meson spins in mesic atoms decreases owing to the presence of conductivity electrons. On the basis of $\bar{a}_0$ and τ, the n, and n_0 level populations in the states F = 1 and F = 0 in phosphorus as well as the λ_1 and λ_0 probabilities of the capture of mesons by the nucleus in these states were calculated. The values found indicated that $\lambda_0 > \lambda_1$. (auth)

25383 (JINR-D-714) II II- ANOMALIES OF THE H^3-SPECTRUM IN THE REACTION $p + d \rightarrow H^3 + \pi^+ + \pi^0$ AT THE PROTON ENERGY OF 670 MeV. Yu. K. Akimov, V. I. Komarov, K. S. Marish, O. V. Savchenko, and L. M. Soroko (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1961. 15p.

The low-energy region of the H^3 momentum spectra at 5.8° in the lab system was measured in (p + d) collisions at the proton energy of 670 Mev. The resonance interaction between two pions in the states with the isotopic spin $T_{\pi\pi} = 1$ and the total energy from 275 to 400 Mev was not confirmed. It was found that the cross section for the two-pion production in the state with $T_{\pi\pi} = 0$ is greater by an order of magnitude than that with $T_{\pi\pi} = 1$, up to the total energy of 400 Mev in the c.m.s. of the two pions. (auth)

25384 (JINR-D-728) APPLICATION OF THE DIFFERENTIAL METHOD FOR OBTAINING THE PHOTOPRODUCTION AMPLITUDE FROM DISPERSION RELATIONS. L. D. Solovyov and Jung-mo Chen (Chen Jung-mo) (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 26p.

Starting from one-dimensional dispersion relations (considered in the observable region) the expression for the amplitude of photoproduction of pions on nucleons at low energies was obtained. The nucleon recoil was taken into account. A satisfactory agreement with experiment

as obtained for angular distributions of neutral pions. uth)

385 (JINR-D-742) A PLAUSIBLE MODEL OF PARTICLE PRODUCTION IN HIGH ENERGY πN COLLI-ON. Shih-ko Hu (Hu Shih-ko) and Yung Wang (Wang Yung) oint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of eoretical Physics). 1961. 5p.

A model for production of Λ hyperons by π-N collisions about 7 Bev/c is studied. The predictions of this model e compared with experimental data, with respect to the timal transverse momentum of the Λ, the forward-ckward peaking of the Λ distribution, and the Λ longitudi-l polarization. (T.F.H.)

386 (NYO-9746) HYPERON—NUCLEON SCATTER-G. J. J. de Swart and C. Dullemond (Rochester, N. Y. iv. and Chicago. Univ. Enrico Fermi Inst. for Nuclear udies). June 20, 1961. 45p.

The hyperon-nucleon scattering is calculated for Λ-oratory energies to 315 Mev. The potentials used were se linear combinations of the nucleon-nucleon potentials prescribed by global symmetry. The mass difference ween the Λ- and Σ-hyperon was taken into account in the ematics. The mass differences between the Σ-hyperons d between the nucleons are neglected. Angular distribu-ns and total cross sections are given for all the possible peron-nucleon scattering reactions. (auth)

387 (PAN-225/VII) ON THE FINAL-STATE INTER-TION IN SINGLE-PION PRODUCTION PROCESSES. ART] I. A. Krzywicki (Polish Academy of Sciences. t. of Nuclear Research, Warsaw). Apr. 1961. 11p.

An evaluation was made of the matrix element corre-onding to a simple field theoretical model of single-pion oduction, taking into account the rescattering of the pro-ed pion. The results can be useful in the analysis of gle-pion production processes for energies of the inci-t pion close to 1 Bev. (auth)

388 (TID-13220) ON THE INTERPRETATION OF E FIELD THEORETICAL POTENTIAL IN TERMS OF ASE SHIFTS. G. Breit (Yale Univ., New Haven). [1961]. ntract AT(30-1)-1807. 50p.

The type of potential introduced by Schwinger in connec-a with quantum electrodynamics and adopted by Gupta nucleon-nucleon interactions is distinguished from the e that is used in a Schroedinger equation involving the rdinates of interacting particles. The application of the son S matrix expansion in terms of plane waves to the culation of the collision matrix is justified by the con-eration of wave packets. Explicit relationships between ressions occurring in Dyson's S matrix in the usual ation and the collision matrix are listed, and it is shown t a non-Hermitian potential can be written that has the perty of reproducing the scattering amplitude in first rn approximation. Explicit relations of these matrices to reactance matrix of nuclear reaction theory are listed alternative procedures of calculating phase shifts and pling parameters by means of the non-Hermitian poten-are discussed. Relativistic correction factors are ana-ed in a form distinguishing between generally occurring tors and those peculiar to pseudoscalar coupling for the ond order potential. Attention is called to a formal ilarity between the success of Dyson's S operator ex-sion in quantum electrodynamics and the qualitative re-duction of phenomenological phase parameter fits by the perator in the nucleon-nucleon case. (auth)

389 (TID-13300) COULOMB FIELD EFFECTS ON E DECAY OF BOUND POLARIZED MUONS. W. R. Johnson, R. F. O'Connell, and C. J. Mullin (University of Notre Dame, Notre Dame, Ind.). [1961]. 20p.

The influence of the Coulomb field on the decay of a polarized μ meson from the K shell of a μ mesonic atom is considered. Analytical results valid to order $\alpha^3 Z^3$ are presented for the total decay rate and for the electron angular distribution. Formulas valid to order $\alpha^2 Z^2$ are given for the energy spectrum of the emitted electron. (auth)

25390 (UCRL-Trans-434) SCATTERING OF PARTICLES OF HIGH ENERGIES. LECTURES READ AT SUMMER CONFERENCE OF YUGOSLAVIAN PHYSICISTS AT LOGSHIRE ISLAND, JULY 13-27, 1957. Part of Lecture 5. Results of Experiments on Scattering of Nucleons by Nucleons and all of Lecture 8. Hyperons and Antinucleons. Ya. (Ia.) A. Smorodinskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). Translated for Univ. of California. 1957. 5p.

Experiments on scattering of nucleons by nucleons are discussed briefly for energies up to several Mev. Hyperon and antinucleon reactions are considered. (W.D.M.)

25391 ELECTRON SCATTERING IN A CRYSTAL LATTICE. Thomas H. Dupree (Massachusetts Inst. of Tech., Cambridge). Ann. Phys. (N. Y.), 15: 63-78(July 1961).

For some types of crystals it is permissible to assume that within a spherical region surrounding each ion the potential is spherically symmetric and that in the inner-space between these spherical regions the potential is constant. Schrödinger's equation is solved for such a potential distribution in which the spherical potential wells are not all alike. Both propagating and nonpropagating solutions are considered. An asymptotic evaluation of the wave scattered by an impurity ion is carried out. From this, a calculation of residual resistance in alkali metal alloys is obtained. (auth)

25392 THE GUIDING CENTER APPROXIMATION TO CHARGED PARTICLE MOTION. Theodore G. Northrop (Univ. of California, Livermore). Ann. Phys. (N. Y.), 15: 79-101(July 1961). (UCRL-5708-T)

The equations governing the guiding center motion of a charged particle in an electromagnetic field are obtained simultaneously and deductively, without considering individually the special geometric situations in which one effect or another occurs alone. The general expression is derived for the guiding center velocity at right angles to the magnetic field B. This expression contains five terms arising in the presence of an electric field. They are in addition to the usual "E × B" drift. Because these terms are unfamiliar objects in the literature on plasmas, they are illustrated by simple examples. Three of the five drifts occur in rotating plasma machines of the Ixion type. One of these three is also shown to be responsible for the Helmholtz instability of a plasma. A fourth one gives the (low frequency) dielectric constant, while the fifth arises if the direction of B is time dependent. A detailed geometric picture of the fifth drift is given. The equation governing the guiding center motion parallel to B is also derived for the general time-dependent field. The conditions are discussed under which it can be integrated into the form of an energy integral. Finally the component of current density perpendicular to B in a collisionless plasma is shown to be the current due to the guiding center drift plus the perpendicular component of the curl of the magnetic moment per unit volume. Proofs of this have been given in the past for special cases, such as static fields, $\nabla \times B = 0$, etc. This proof holds in general, provided conditions for adiabaticity are met. It is also true, but not proven in this

paper, that the component of the current density parallel to B is the current due to the guiding center velocity parallel to B plus the parallel component of the curl of the magnetic moment per unit volume. A proper proof of the parallel component is quite lengthy. (auth)

25393 A POSSIBLE MECHANISM OF THE $D_{3/2}$, $T = 1/2$ RESONANCE IN PION-NUCLEON SCATTERING. W. Krolikowski (Univ. of Warsaw). Bull. acad. polon. sci. Sér. sci., math., astron. et phys., 9: 303(1961). (In English)

A confirmation of the existence of the $D_{3/2}$, $T = 1/2$ for the second $\pi - p$ resonance is presented, assuming that the contribution from the state $J = 3/2$, $T = 1/2$ predominates over other D states in integrals I_{JT} and J_{JT}. The formulas for the D effective ranges are given. (N.W.R.)

25394 ON THE FINAL-STATE INTERACTION IN SINGLE-PION PRODUCTION PROCESSES. A. Krzywicki (Inst. for Nuclear Research, Warsaw). Bull. acad. polon. sci. Sér. sci., math., astron. et phys., 9: 305-11(1961). (In English)

A simple method for evaluating the matrix element corresponding to the rather complicated model of the single pion production process is presented. The advantages of this calculation method is that other final-state pion–nucleon resonant interactions can be evaluated. The distribution of this method is similar to that of the isobar theory. This method is only for energies close to 1 Bev and higher. (N.W.R.)

25395 ON THE ANTILINEARIZATION OF THE KLEIN-GORDON EQUATION FOR 4-SPINOR. J. Lukierski (Univ. of Wroclaw, Poland). Bull. acad. polon. sci. Sér. sci., math., astron. et phys., 9: 317-21(1961). (In English)

The most general mass operator of a 4-spinor notation is described by means of the relation of two real isovectors and leads to the generalized antilinear Dirac equation. The derivation of the mass operator is accomplished by generalization of the scalar operators and from 4-spinor equations derived by other theoreticians. (N.W.R.)

25396 A CONTRIBUTION TO RESEARCH INTO INTERACTION BETWEEN π-MESONS AND ATOMIC NUCLEI. J. Tucek (Inst. of Physics, Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys., B11: 459-61 (1961). (In English)

A study is made of the π^--nucleus interaction at 4.5 Bev. Analysis of the meson multiplicities and evaporation phenomena of 420 events in emulsion indicate that the mean number of emitted protons is independent of both the energy transfer and of secondary $(\pi^{\pm},p)$ interactions in the nucleus. (T.F.H.)

25397 STOCHASTIC EQUATIONS IN RADIATIVE TRANSFER BY INVARIANT IMBEDDING METHOD. Sueo Ueno (Univ. of Kyoto). J. Math. Anal. and Appls., 2: 217-22(Apr. 1961).

A derivation is given of the basic set of stochastic integro-differential equations for the probability distributions of photons from a plane-parallel inhomogeneous medium of finite optical thickness τ_1. Invariant imbedding techniques are used for the reflected and transmitted fluxes and for the probability distributions of the fluxes in one-dimensional neutron transport theory. The length of the rod is treated as an essential parameter of the process. In the case of internal fluxes, attention is focussed upon an interior point that has suppressed boundary-dependence. (N.W.R.)

25398 THE BACK-SCATTERING OF BETA RAYS–AN INTRODUCTION FOR INDUSTRIAL APPLICATION. Michael v. Rimscha (Staatliche Ingenieurschule, Kiel). Kerntechnik, 3: 264-7(June 1961). (In German)

The scattering and absorption of beta particles is discussed first in a general way and then with special consideration to the process of backscattering. The discussion is complemented by diagrams suitable for the technical application of backscattering. (auth)

25399 SPEED AND MASS OF THE ELECTRON IN AN ELECTRIC FIELD. S. I. Zilitinkevich. Nauch. Trudy Leningrad. Inst. Toch. Mekhan. i Opt., No. 29, 35-44(1959).

The relativistic equation of electron energy conservation in an electric field is transformed for calculating the electron speed. Approximate formulas are proposed for computing the dependence of the electron speed on the potential difference passed by it, and their errors are analyzed. Moreover, the exact and approximate formulas are presented for computing the electron mass. (Referat. Zhur. Fiz., No. 7, 1960)

25400 A SEPARABLE POTENTIAL FOR THE TWO-NUCLEON ($T = 1$) INTERACTION. A. N. Mitra (Univ. of Delhi) and J. H. Naqvi. Nuclear Phys., 25: 307-16(1961). (In English)

A separable potential in the isobaric state $T = 1$ is proposed on the basis of p–p scattering data up to about 100 Mev. The triplet part of this potential is taken to be purely of the spin-orbit type, with a range about half of that of the singlet potential. Potentials in states $l \geq 3$ are neglected. It is found that such a potential can rather satisfactorily explain the angular shape of the unpolarized cross section as well as the magnitude of the polarization in scattering up to 100 Mev. (auth)

25401 ANTINUCLEON-NUCLEON ANNIHILATION TO TWO MESONS. R. J. N. Phillips (A.E.R.E., Harwell, Berks, Eng.). Nuclear Phys., 25: 348-52(1961). (In English)

A partial wave description is given for two-meson annihilation in flight. Angular distributions and polarization effects are illustrated; they are sensitive to the range of the annihilation region. (auth)

25402 ON A SYMMETRICAL SCHEME OF INTEGRAL EQUATIONS FOR SPECTRAL FUNCTIONS. K. Ter-Martirosyan (Inst. of Experimental and Theoretical Physics, Academy of Sciences, Moscow). Nuclear Phys., 25: 353-67(1961). (In English)

A self-contained set of integral equations for the spectral functions of the scattering amplitudes was obtained in two-particle approximation. The equations are perfectly symmetrical with respect to the three channels of the "four-tail" vertex; if the Mandelstam spectral representations are written with allowances for the subtraction, there arises a coupled set of equations connecting the spectral functions of two types: depending on two variables and on one variable. The iteration of the equations over the coupling constants yields the contribution of a class of renormalized Feynman graphs consisting in each part of two parts connected by two lines (only a portion of the contribution of these graphs is adequately taken into account, viz. that which has singularities at the two-particle production threshold). If the spectral functions depending on two variables are neglected, there remain the equations of the type obtained by Chew and Mandelstam and by Cini and Fubini. (auth)

25403 EQUATIONS FOR SPECTRAL FUNCTIONS IN THE SIMPLEST CASES. K. Ter-Martirosyan (Inst. of Experimental and Theoretical Physics, Academy of Sciences, Moscow). Nuclear Phys., 25: 368-84(1961). (In English)

The integral equations for the spectral functions of

four-tail" amplitudes are written in detail for the case hen two of the four particles are identical. The equations btained are applicable to the cases of $\pi-\pi$, $\pi-K$, and $K-K$ teractions, the spins and isospins of all particles being ssumed equal to zero. (auth)

5404 PHOTOPRODUCTION OF NEUTRAL MESONS HELIUM. J. L. Cook (Cambridge Univ., Eng.). Nuclear hys., 25: 421-30(1961). (In English)

For photon energies above 280 Mev, it is found that the xperiments for elastic photoproduction of π^0 mesons can e explained in the impulse approximation. At lower ener- es, multiple scattering is large and is estimated using e method of Chappelear. The r.m.s. radius of He^4 is de- rmined, from the experiments at 290 Mev by Palit and ellamy, and is found to be 1.5 ± 1 fm, for eight different ave functions. (auth)

5405 RELATION BETWEEN THE BARE AND PHYSI- AL MASSES OF VECTOR MESONS. Kenneth Johnson mperial Coll. of Science and Tech., London). Nuclear nys., 25: 435-7(1961). (In English)

Assuming the usual canonical commutation relations to ld, a relation is found between the bare and the physical asses of vector mesons, which implies that the physical ass of the photon is zero. (auth)

5406 COLLECTIVE CORRELATION BETWEEN ACUUM NUCLEONS IN PS–PS MESON THEORY. Osamu ara (Univ. of Minnesota, Minneapolis). Nuclear Phys., : 472-82(1961). (In English)

The effect of the collective correlation between vacuum ucleons is calculated using an approximation in which the netic energy of the nucleons is neglected as compared ith their rest energy. The point is that there can exist a rong collective correlation between vacuum nucleons just between electrons in metal, since interactions between cuum nucleons due to pions are dominantly attractive. It shown that this effect can play in fact an important role, this attractive interaction is sufficiently strong, and that e low energy behavior of the phase shift δ_3 of the S-wave on-nucleon scattering and the position of the (33) reso- nce are rather sensitive to this effect. As an example, e phase shift δ_3 is calculated using a Tamm-Dancoff ap- roximation including up to two pions and one nucleon- tinucleon pair. It is shown that the result agrees rea- nably well with experiment if parameters specifying the rength and the range of the attractive potential are osen suitably. (auth)

5407 SEPARATION OF HIGH ENERGY PARTICLES Y MEANS OF STRONG INTERACTIONS. G. Goldhaber ERN, Geneva), S. Goldhaber, and B. Peters. Nuclear nys., 25: 502-10(1961). (In English)

A method is discussed by which nucleons and pions itted from an accelerator target can be eliminated pref- entially so that one obtains beams which consist mainly antinucleons and K mesons. The method which is appli- ble to relativistic particles is not confined to the range energies which are available in the laboratory. At the ERN Proton Synchrotron secondary particle production is fficiently high to make such separated beams of antinu- eons and K mesons useful for bubble chamber work up to rticle momenta well above 8 Bev/c. (auth)

5408 AN EXPERIMENTAL EXAMINATION OF HEORIES RELATING THE ABSORPTION OF γ-RAY NERGY IN A MEDIUM TO THE IONIZATION PRODUCED A CAVITY. T. E. Burlin (Hammersmith Hospital, ndon). Phys. in Med. Biol., 6: 33-53(July 1961).

The results of calculations, employing values of average excitation potentials from a recent review, are presented for both the Bragg-Gray theory and the Spencer-Attix theory of cavity ionization. The variation of ionization with the pressure, the atomic number of the gas, and the atomic number of the chamber wall predicted by these theories are compared with measured values. The experimental results agree closely with the theoretical predictions of Spencer and Attix, except for hydrogen at low pressures. This discrepancy is attributed in part to the transfer of slow electrons between electrodes. (auth)

25409 HELICITY OF μ^- MESONS; MOTT SCATTERING OF POLARIZED MUONS. Marcel Bardon, Paolo Franzini, and Juliet Lee (Columbia Univ., New York). Phys. Rev. Letters, 7: 23-5(July 1, 1961).

In order to find the helicity of the neutrino ν_μ associated with the μ meson, the reaction $\pi^- \rightarrow \mu^- + \bar{\nu}_\mu$ is studied. The helicity is found from the asymmetry in the Mott scattering of the polarized μ^- mesons produced in the reaction. It is found that the helicities of the ν_μ and ν_e are equal. (T.F.H.)

25410 ANOMALY IN MESON PRODUCTION IN p + d COLLISIONS. Norman E. Booth, Alexander Abashian, and Kenneth M. Crowe (Univ. of California, Berkeley). Phys. Rev. Letters, 7: 35-9(July 1, 1961).

A study is made of p-d reactions in which $He^3 + \pi^0$, $He^3 + \omega^0$, $He^3 + \pi^+ + \pi^-$, $He^3 + \pi^0 + \pi^0$, $H^3 + \pi^+$, $H^3 + \omega^+$, and $H^3 + \pi^+ + \pi^0$ are produced. The ω is an assumed particle with a mass between 1 and 2.8 times that of the π meson. An anomalous peak is found in the He^3 spectra that behaves kinematically like a resonance of mass 310 Mev. It is shown that this resonance may be explained as a strong S-wave π-π attractive mode in the I = 0 state, or as an He^3–π final state interaction. (T.F.H.)

25411 NUCLEON-NUCLEON COLLISIONS AND PI-MESON-NUCLEON COLLISIONS LEADING TO MULTI-PARTICLE PRODUCTION WITH HIGH ENERGY ACCELERATORS. Oleg Czyżewski and Roman Holyński (Inst. for Nuclear Research, Krakow). Postepy Fiz., 12: 71-87 (1961). (In Polish)

The experimental results discussed are from the work at Berkeley and Dubna, with some results as yet unpublished from CERN. The statistical hydrodynamic theory of Fermi, dealing with a collection of structureless nuclei, is put to a severe test in the creation of stars in nuclei by energetic particles (several Bev) whose de Broglie wave length is the order of 10^{-14} cm in the center-of-mass system. Such probing particles are expected to yield information relating to the structure of a nucleon. In the production of stars by pi-nucleon and proton-neutron reactions, perhaps the greatest disagreement with the predictions of the Fermi theory lies in the strong anisotropies observed, especially in the few-pronged stars. It is not as yet known whether the isobaric model can adequately account for these observations, but the work of Tamm and Czerniawski lends credence to this model. If the star production can be explained by interaction with the meson cloud of a nucleon, then indeed the core of a nucleon must be relatively small compared to its over-all extent. The interaction mechanism of a meson or a nucleon with an atomic nucleus can be explained either by a cascade process or by the interaction with clusters of target nucleons. An understanding of the mechanism of interaction with atomic nuclei must be preceded by a better knowledge of the meson-nucleon or nucleon-nucleon interaction, or from the determination of the structure of the nucleon. (TTT)

25412 THE ENERGY LOSS OF SINGLY CHARGED HEAVY RELATIVISTIC PARTICLES IN AN ORGANIC

MATERIAL. C. F. Barnaby (University Coll. Hospital Medical School, London and Northern Polytechnic, London). Proc. Phys. Soc. (London), 77: 1149-56(June 1, 1961).

An experiment is described in which a large area plastic scintillation counter is used to measure the energy loss of relativistic μ-mesons. The results, which are not dependent on the method used to fit the data to the Landau distribution, show that the increase in the most probable energy loss is less than 1% for mesons of energies between 500 and at least 10,000 Mev. This conclusion is consistent with the Sternheimer density correction to the ionization loss. (auth)

25413 NEW HEAVY BOSONS. H. Frölich (Univ. of Liverpool). Proc. Phys. Soc. (London), 77: 1223(June 1, 1961).

A wave equation is considered that includes all known bosons. The symmetries involved in this equation imply the existence of four bosons that are not observed. These unobserved bosons have spin 1, mass larger than that of the K meson, and comprise a positive, a negative, and two neutral particles. It is noted that the existence of these bosons may also be inferred from the empirical properties of weak interactions. (T.F.H.)

25414 CONFERENCE ON STRONG INTERACTIONS, UNIVERSITY OF CALIFORNIA, BERKELEY, CALIFORNIA, DECEMBER 27-29, 1960. Revs. Modern Phys., 33: 355-498(July 1961).

Twenty-two papers were presented at the Conference on Strong Interactions. Separate abstracts were prepared for each paper. (L.T.W.)

25415 310 MEV Pi^+-p POLARIZATION AND CROSS-SECTION EXPERIMENTS. PHASE-SHIFT ANALYSIS. Ernest H. Rogers, Owen Chamberlain, James H. Foote, Herbert M. Steiner, Clyde Wiegand, and Tom Ypsilantis (Univ. of California, Berkeley). Revs. Modern Phys., 33: 356-61(July 1961).

The cross sections and proton polarizations in π^+-p interactions at 310 Mev are measured, in an attempt to find an unambiguous set of SP, SPD, or SPDF phase shifts for the system. The experimental data can be made to fit unambiguously a given set of SPD phase shifts. The data cannot be fitted adequately by a set of SP shifts alone, and the data are fitted ambiguously by several sets of SPDF shifts. (T.F.H.)

25416 PARTIAL CROSS SECTIONS NEAR THE HIGHER RESONANCES. P. Falk-Vairant and G. Valladas (C.E.N., Saclay, France). Revs. Modern Phys., 33: 362-7(July 1961).

Recent measurements of charge-exchange cross section and π^0 production in π^--p interactions are presented. A summary of the known results for the elastic, inelastic, and charge-exchange cross sections is given. The behavior of the cross sections in the $T = \frac{1}{2}$ state is presented so that the resonances at 600 and 890 Mev may be discussed. The charge-exchange scattering and the interference term between the $T = \frac{1}{2}$ and $T = \frac{3}{2}$ states are described. Some comments on inelastic processes are given. (L.T.W.)

25417 Pi^--p ELASTIC SCATTERING IN THE ENERGY REGION 500-1500 MEV. Burton J. Moyer (Univ. of California, Berkeley). Revs. Modern Phys., 33: 367-73(July 1961).

A survey is presented of elastic scattering data for the p-π^- system in the energy region of the 600- and 900-Mev peaks. The principal emphasis in the presentation is on recent data secured by Wood et al. (Bull. Am. Phys. Soc., 5: 509(1960)). (L.T.W.)

25418 PRODUCTION OF HYPERONS IN HYDROGEN BY POSITIVE PIONS. C. Baltay, H. Courant, W. J. Fickinger, E. C. Fowler, H. L. Kraybill, J. Sandweiss, J. R. Sanford, D. L. Stonehill, and H. D. Taft (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.). Revs. Modern Phys., 33: 374-81(July 1961).

The rise of the cross section for Σ^+K^+ production with increasing incident energy indicates that both S- and P-wave production are important. The angular distribution of the Σ^+ particles changes rapidly with incident energy over the interval observed in this experiment. At 1090 and 1260 Mev the distributions require the presence of more than S- and P-wave angular momentum states. It is interesting to speculate as to whether some simple combination of S, P, and D wave may be found which will fit these data well. On comparing with previous results from π^- experiments, within experimental errors, the results for 1090 Mev are consistent with the hypothesis of charge independence. It appears that there is a considerable angular interval for Σ^{+}'s in the backward hemisphere in which $(2\sigma_0)^{1/2} = (\sigma_+)^{1/2} + (\sigma_-)^{1/2}$, approx. For the 1090-Mev part of this experiment with a total of 327 Σ^{+}'s, there were 173 which decayed to $\pi^+ + n$ and 154 which decayed to $\pi^0 + p$. Within statistical errors, these decays are symmetrical with respect to the normal to the plane of Σ^+K^+ production. Since the previous bevatron counter study of parity conservation[2] in decay of Σ^{+}'s produced at 990 Mev gave the value of $\alpha\overline{P}_0 = 0.75 \pm 0.17$, we conclude that at 1090 Mev the polarization of the Σ^{+}'s is small. This change in polarization seems consistent with the considerable change in the angular distribution of the Σ^{+}'s between 980 and 1090 Mev observed in the present experiment, although as yet that question has not been investigated in detail. (auth)

25419 RECENT WORK ON STRONG INTERACTIONS AT CERN. A. M. Wetherell (CERN, Geneva). Revs. Modern Phys., 33: 382-9(July 1961).

Some data on the total cross sections, including diffraction scattering, for p-p and $\bar{p}$-p collisions at high energies are described. The $K^+ - p$ and $K^- - p$ cross sections are discussed. Preliminary results on the Λ and neutral K meson angular and momentum distributions are compared with some recently analyzed Σ^+ and Σ^- data from $V^{\pm}$ events. Preliminary data from elastic and inelastic protons-nucleon scattering at high energies are described. (L.T.W.)

25420 K-NUCLEON INTERACTION. Leroy T. Kerth (Univ. of California, Berkeley). Revs. Modern Phys., 33: 389-92(July 1961). (UCRL-9708)

The K-proton data may be characterized by a very high cross section at low momentum, varying apparently as approximately 1/v, with a resonance appearing at about 1 Bev/c, and a final asymptotic value at high energy of about 25 mb. K^--neutron data do not exist at low energies, so the very low energy behavior of the K^--neutron total cross section is not known; however, at higher energies it seems to be approaching the same value as the K^--proton data. Therefore we say that at high energy the T = 1 and T = 0 states are approximately equally effective. The resonance appears only in the T = 0 state and not in T = 1 state. In the K^+ interaction, the T = 1 state has a rather simple total cross section behavior rising very slowly at low energies to an asymptotic value of approximately 20 mb at high energies. The T = 0 total cross section, however, starts at a rather low value at zero momentum, increases to about the same value as in the T = 1 state in the region of 500 Mev/c, and then remains equal to the T = 1 state at high energies. On the angular distributions measured in the lower energy K^+-nucleon experiments, one can say that the T = 1 scattering appears to be predominantly S wave

below 800 Mev/c, whereas the T = 0 state is very much more complicated, requiring up to D waves to fit the data. (auth)

25421 DOUBLE MESON PRODUCTION IN PROTON-DEUTERON COLLISIONS. Norman E. Booth, Alexander Abashian, and Kenneth M. Crowe (Univ. of California, Berkeley). Revs. Modern Phys., 33: 393-4(July 1961).

In a previous publication (Abashian et al., Phys. Rev. Letters, 5: 258(1960)) measurements were reported on the momentum spectra of He^3 and H^3 nuclei produced in collisions of 740-Mev protons with deuterons. The He^3 spectrum exhibited an anomaly in the form of a peak in the region corresponding to double pion production. For reactions resulting in He^3, the two pions (or particle) can be in isotopic spin states 0 or 1; if a H^3 nucleus results, only I = 1 is allowed. The experiment was repeated with a new arrangement which enabled both the He^3 and the H^3 spectra to be measured with improved resolution and accuracy. It is concluded that the anomaly must be assigned an isotopic spin I = 0. (L.T.W.)

25422 FINAL STATES OF THE ANTIPROTON–PROTON SYSTEM. Gerald R. Lynch (Univ. of California, Berkeley). Revs. Modern Phys., 33: 395-401(July 1961). (UCRL-9581)

Some of the results from two antiproton experiments are reported. The beam momentum at the center of the 72-in. bubble chamber was 1.61 Bev/c for the first experiment and and 1.99 Bev/c for the second. (L.T.W.)

25423 Pi-Pi CORRELATIONS IN $\bar{p}$-p ANNIHILATION. Gerson Goldhaber and Wonyong Lee (Univ. of California, Berkeley). Revs. Modern Phys., 33: 402-6(July 1961).

The $\bar{p}$-p annihilation process leading to pure pion production affords an opportunity to examine possible pion-pion interactions. An analysis of annihilation events in propane was made. The events chosen were "hydrogen like," i.e., events showing no visible evaporation prongs and with $N_{\pi^+} = N_{\pi^-}$. The distribution of angles between pions of like and unlike charge in the $\bar{p}$-p c.m. system as well as the distribution of total energy of pion pairs of like and unlike charge in their c.m. system was examined. (L.T.W.)

25424 SOME CONSIDERATIONS CONCERNING FINAL-STATE INTERACTIONS AND THE REACTION $K_2^0 + p \rightarrow$ LAMBDA^0 + Pi^+ + Pi^0. Robert K. Adair (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.). Revs. Modern Phys., 33: 406-15(July 1961).

An experiment designed to study the interactions of K_2^0 mesons with protons is reported. An analysis is made of the effect of symmetries and angular momentum barriers, particularly as applied to the reaction $K_2^0 + p \rightarrow \Lambda^0 + \pi^+ + \pi^0$. The properties of resonant final-state interactions are discussed. Experimental results and interpretations are given concerning the reaction $K_2^0 + p \rightarrow \Lambda^0 + \pi^+ + \pi^0$. (L.T.W.)

25425 PION-HYPERON RESONANCES. Margaret H. Alston and Massimiliano Ferro-Luzzi (Univ. of California, Berkeley). Revs. Modern Phys., 33: 416-26(July 1961). (UCRL-9587)

The experimental data available on the $\Lambda\pi$ resonance (Y_1^*) are reviewed and discussed. The effect of the resonance in various interactions is shown. (L.T.W.)

25426 SOME SPECULATIONS ON THE NEW RESONANCES. Abdus Salam (Imperial Coll. of Science and Tech., London). Revs. Modern Phys., 33: 426-30(July 1961).

Some speculations regarding the four new resonances (Y^*, Λ^*, K^*, W^0) in strange particle interactions are advanced. (L.T.W.)

25427 PION-PION INTERACTIONS. Jerry A. Anderson, Vo X. Bang, Philip G. Burke, D. Duane Carmony, and Norbert Schmitz (Univ. of California, Berkeley). Revs. Modern Phys., 33: 431-4(July 1961). (UCRL-9585)

Pion-pion interactions in π-N processes are discussed, using a π^+ and π^- beam at 1.03 Bev/c. (L.T.W.)

25428 PION-PION INTERACTIONS AND PION PRODUCTION BRANCHING RATIOS AT THE THIRD RESONANCE. E. O. Salant, E. Pickup, D. K. Robinson, and B. A. Munir (Brookhaven National Lab., Upton, N. Y.). Revs. Modern Phys., 33: 435-6(July 1961).

Branching ratios for incident pion kinetic energies from 810 to 1100 Mev are tabulated. Pion-pion interactions and pion production branching ratios at the third resonance are discussed. (L.T.W.)

25429 PROGRESS REPORT ON AN EXPERIMENT TO STUDY LAMBDA^0–K^0 PRODUCTION AT SIGMA-K THRESHOLD. F. Eisler, P. Franzini, J. M. Gaillard, A. Garfinkel, J. Keren, R. Plano, A. Prodell, and M. Schwartz (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.). Revs. Modern Phys., 33: 436-8(July 1961).

The process $\pi^- + p \rightarrow \Lambda^0 + K^0$ was studied. Approximately 100,000 pictures were taken, yielding events. These events were analyzed to determine center of mass, production angle, and Λ^0 decay asymmetry angle. For simplicity, the data were broken into three energy groups. For reference, the threshold occurs at about 902 Mev. The angular distributions are not easily fit by just s and p waves. The difficulty for the most part lies in the disproportionately large number of events in the backward 10% of solid angle. In fact, if the two groups of higher energy data are combined, then the best fit to $A + B\cos\theta + C\cos^2\theta$ is about three standard deviations from the observed distribution. The total $\Lambda - K$ cross section at this point is quite high — in fact, 50% higher than it is at 960 Mev. Also, there is a resonance in the total $\pi^- - p$ cross section at 900 Mev which is known to have total angular momentum $5/2$. If the magnitude of the $\Lambda - K$ cross section is substantially influenced by this resonance, then one might expect appreciable $\cos^3\theta$ and $\cos^4\theta$ contribution. There is a considerable flattening out of the angular distribution in the immediate vicinity of the threshold. This is best illustrated by noting the change in the backward-forward ratio as a function of energy. The difference between the highest energy group and the threshold group is ~ two standard deviations. Finally, there seems to be some sign of decreasing polarization in the neighborhood of the threshold. (auth)

25430 THE CUSP IN LAMBDA-K PRODUCTION AT SIGMA-K THRESHOLD. Sanford E. Wolf, Norbert Schmitz, Lester J. Lloyd, William Laskar, Frank S. Crawford, Jr., Janice Button, Jared A. Anderson, and Gideon Alexander (Univ. of California, Berkeley). Revs. Modern Phys., 33: 439-47(July 1961).

25431 ANOMALOUS THRESHOLDS. R. E. Cutkosky (Carnegie Inst. of Tech., Pittsburgh). Revs. Modern Phys., 33: 448-55(July 1961).

Anomalous thresholds are a very general feature of the scattering matrix and their principal characteristics can be understood from simple examples which do not require formal arguments based on analytic continuation. The role of anomalous thresholds in S-matrix theory is shown completely, however, only when one considers the analytic

continuations to complex momenta and energies. The study of anomalous thresholds has led to a clarification of the role of elementary wave mechanics in a pure S-matrix theory. In a certain sense, the Schrödinger equation can be considered as just a reflection of the anomalous thresholds. On the other hand, the study of singularities in perturbation theory amplitudes has pointed out the existence of previously unnoticed relations between S-matrix elements. These relations are necessary to a calculation of the S matrix from the assumption of analyticity. The construction of the S matrix from these rules may be expressed in terms of a graphical calculus as suggested by Landau. This graphical calculus is equivalent to the ordinary formulations of field theory. (auth)

25432 RECENT PROGRESS IN THE DISPERSION THEORY OF PION-NUCLEON INTERACTIONS. Sergio Fubini (Instituto di Fisica dell'Universitá, Padova, Italy and CERN, Geneva). Revs. Modern Phys., 33: 455-7 (July 1961).

The application of dispersion theory to pion-nucleon interactions is discussed. An attempt is made to explain the basic physical ideas which are at the origin of this approach and to discuss the main points where the theoretical understanding of the experimental situation has improved. (L.T.W.)

25433 PERIPHERAL CONTRIBUTIONS TO HIGH-ENERGY INTERACTION PROCESSES. S. D. Drell (Stanford Univ., Calif.). Revs. Modern Phys., 33: 458-66 (July 1961).

Collisions of strongly coupled particles were studied. Peripheral contributions to the interactions are reported. (L.T.W.)

25434 A UNIFIED DYNAMICAL APPROACH TO HIGH- AND LOW-ENERGY STRONG INTERACTIONS. Geoffrey F. Chew (Univ. of California, Berkeley). Revs. Modern Phys., 33: 467-70(July 1961). (UCRL-9515)

The Mandelstam diagram and strip approximation are reviewed. Asymptotic behavior in strip directions and dynamical equations for strips are reviewed. (L.T.W.)

25435 ON THE STRONG INTERACTIONS OF THE STRANGE PARTICLES. R. H. Dalitz (Univ. of California, Berkeley). Revs. Modern Phys., 33: 471-92(July 1961). (UCRL-9580)

The theory appropriate to the definition and application of the reaction matrix is reviewed. The analysis of the low-energy K^--proton data is reviewed in terms of this formalism, and the $\bar{K}$ -nucleon virtual bound state interpretation of the π-Λ resonance is compared with experimental data. The use of this formalism and its relationship with the reaction-matrix formalism are discussed, with special reference to the description of resonant states. The present evidence bearing on the validity of the global symmetry hypothesis is reviewed, and the interpretations of the π-Λ resonance as an analog of the (3,3) isobar state in the π-N system are discussed and compared with data. (L.T.W.)

25436 ON SYMMETRIES SHARED BY STRONG AND WEAK INTERACTIONS. Abraham Pais (Institute for Advanced Study, Princeton, N. J.). Revs. Modern Phys., 33: 493-7(July 1961).

Parity violations in nonleptonic decays are discussed. Symmetries shared by strong and weak interactions are analyzed. (L.T.W.)

25437 SCATTERING OF μ MESONS AND ELECTRONS BY PROTONS. Pei Wang and Tso-hsien Ho (Peking Univ.). Sci. Sinica (Peking), 10: 63-9(May 1961). (In Russian)

An experimental method is suggested for verifying the magnetic structure of electrons. The effects of proton scattering of μ mesons and electrons possessing electromagnetic structure were calculated with single-photon approximation and considering polarization. (tr-auth)

25438 ON THE DIFFUSION OF RADIATION WITH REDISTRIBUTION IN FREQUENCY IN A ONE-DIMENSIONAL MEDIUM. V. V. Ivanov. Vestnik Leningrad. Univ., No. 19, Ser. Mat. Mekhan. i Astron, No. 4, 117-23(1960).

The diffusion of radiation with complete redistribution in frequency in a one-dimensional semi-infinite medium is discussed. The diffusion is isotropic and the optical thickness of the medium is infinite. The calculation of the radiation fields leads to an equation of convolution type. With the aid of the method of V. V. Sobolev, the simple relation $\phi(\tau) = \int p(\tau, x')\alpha(x')dx'$, where $\alpha(x)$ is the ratio of the absorption coefficients for the frequency x and for the center of the line, exists between $\phi(\tau) = \Gamma(0,\tau)$, where $\Gamma(\tau,\tau')$ is the resolvent of the mentioned convolution equation, and between the probability $p(\tau,x)$ that a quantum absorbed in the depth τ leaves the medium with frequency x. The Laplace transform is $\bar{\phi}(s) = H_1(s) - 1$, where $H_1(\alpha(x)) = H(x)$. An investigation of the asymptotic behavior of the auxiliary function $H(x)$ allows the determination of asymptotic formulas for the probability of escape at a large depth. (OTS)

25439 PARTICIPATION OF π^0-MESONS IN ELECTROMAGNETIC PROCESSES. V. N. Baier and V. V. Sokolov. Zhur. Eksptl'. i Teoret. Fiz., 40: 1233-4(Apr. 1961). (In Russian)

Various processes for the direct interaction of π^0 mesons with the electric field are considered in which such mesons can be created. The cross sections for direct creation processes such as $e + e \rightarrow e + e + \pi^0$ are quite small due to the relatively long lifetime of the π^0-meson. Similarly, processes are considered in which the π^0 is created through a branch of the diagram, for example in photon-photon scattering following $e^+ + e^- \rightarrow 3\gamma$. The largest cross section is found to be from $e^+ + e^- \rightarrow \pi^0 + \gamma$, and it is of the order of 10^{-36} cm^2. Further it is noted that the existence of a neutral vector meson of mass $M \sim 3\mu$ might be detected in this way. If its lifetime for decay to $\pi^0 + \gamma$ is of the order of 10^{-20} to 10^{-21} sec, then the production cross section in the region of the resonance should be 10^{-27} to 10^{-28} cm^2, which is much larger than the production cross section of π^0-mesons by any electromagnetic process. (TTT)

Neutron Physics

25440 (ORNL-2639) CALCULATIONS OF NEUTRON AGE IN H_2O AND OTHER MATERIALS. H. Goldstein, J. C. Sullivan, Jr., R. R. Coveyou, W. E. Kinney, and R. R. Bate (Oak Ridge National Lab., Tenn.). July 12, 1961. Contract W-7405-eng-26. 56p.

The Chronos Code and the Corn Pone Code, were used to calculate neutron slowing-down and flux ages, respectively, of fission and monoenergetic sources in H_2O, D_2O, O, H, Be, BeO, C, oil, and diphenyl. The calculations for H_2O and D_2O were the most extensive and included investigations of the effects of isotropic versus anisotropic scattering in oxygen and deuterium, and the variation of age with terminal or source energy. For H_2O the assumption of anisotropic scattering in oxygen led to a slowing-down age for fission neutrons of 25.53 ± 0.3 cm^2, compared to 24.57 ± 0.3 cm^2 for isotropic scattering in oxygen. The anisotropy assumption did not affect the slowing-down ages for monoenergetic

sources in H_2O below 3 Mev, but at 5 Mev and above the increase in age when anisotropy was included became 10% or greater, although a constancy observed between 10 and 18 Mev remains unexplained. For D_2O anisotropic scattering in oxygen was assumed throughout and the effect of isotropic versus anisotropic scattering in deuterium was investigated. It appeared to have no effect on the slowing-down age for fission neutrons, the value being 111.5 cm^2 in either case. This is explained by the average energy of the fission spectrum, 2.0 Mev, being close to a crossover energy of 2.5 Mev, below which the anisotropy effect decreased the age for monoenergetic sources and above which it increased the age. A small admixture of H_2O lowered the age of D_2O at the rate of about 4.5% for each 1% of H_2O in the solution. The slowing-down ages for fission neutrons in Be and BeO were calculated to be 67.74 ± 0.7 cm^2 and 75.50 ± 1.34 cm^2, respectively, assuming isotropic scattering in beryllium in the center-of-mass system. (auth)

25441 (PAN-219/IX) MILNE'S PROBLEM FOR TWO ADJACENT HALF SPACES R. Zelazny and A. Kuszell (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1961. 6p.

An application is made of the method developed by K. M. Case in the one-velocity neutron transport theory to Milne's problem for two adjacent half spaces, characterized by different properties with respect to the migration of neutrons. (auth)

25442 (PAN-226/IX) TWO-GROUP APPROACH IN NEUTRON TRANSPORT THEORY IN PLANE GEOMETRY. R. Zelazny and A. Kuszell (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). May 1961. 18p.

A generalization is given of Case's method of solution of the one-velocity Boltzmann equation in neutron transport theory with isotropic scattering of neutrons to the two-group approach in the field. The continuous and discrete eigenfunctions (distributions) were derived and the completeness theorem was demonstrated, which allows the recording of the general solution of the two-group Boltzmann equations. For illustration of the application of the presented theory two examples are discussed: the albedo problem for a half space, and the critical problem for a slab. (auth)

25443 DIFFUSION LENGTH OF THERMAL NEUTRONS IN WATER FROM 23°C TO 244°C. M. Reier and J. A. de Juren (Westinghouse Electric Corp., Pittsburgh). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 14: 18-24(Apr. 1961). (In English)

The diffusion length, L, of thermal neutrons is measured in water at 23 to 244.4°C using an Sb^{124}–Be(25 kev) source. The technique for correcting the data for the presence of a source term in the diffusion equation is outlined. The values reported are compared with a theoretical model that calculates the transport mean free path and the absorption cross section averaged over the velocity weighted neutron spectrum. The values for L (corrected to a water density of one) vary from 2.775 cm at 23°C to 3.497 cm at 244.4°C. (auth)

25444 A RECALIBRATION OF THE NBS STANDARD THERMAL NEUTRON FLUX. E. R. Mosburg, Jr. and W. M. Murphey (National Bureau of Standards, Washington, D. C.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 14: 25-30(Apr. 1961). (In English)

The Standard Thermal Neutron Flux of the National Bureau of Standards is recalibrated in terms of the thermal neutron absorption cross section of gold. This is accomplished by β-γ coincidence counting of activated gold foils approximately 0.001 in. and 0.00025 in. thick in a 4π-scintillation counter geometry. The value obtained is 4167 neutrons/cm^2 sec ± 1.5 per cent. When averaged with a previous calibration made with boron foils the final value for the cadmium difference flux is 4203 neutrons/cm^2 sec ± 1.5 per cent. Measurement of the cadmium ratio for various thicknesses of gold yields a value of 0.0235 ± 2 per cent for the epithermal flux parameter, r, of Westcott's convention. Using this convention the value of the flux is 4225 neutrons/cm^2 sec ± 1.5 per cent. (auth)

25445 NEUTRON ABSORPTION. Friedrich Wolf. Kerntechnik, 3: 271-3(June 1961). (In German)

Neutron absorption by boron-containing material is described. Production, processing, and testing are explained in detail. (auth)

Nuclear Properties and Reactions

25446 (AD-254142) MATHEMATICAL FOUNDATIONS OF SCATTERING THEORY. Reese T. Prosser (Massachusetts Inst. of Tech., Lexington. Lincoln, Lab.). Apr. 5, 1961. 20p.

A description of the mathematical foundations of the quantum theory of scattering is presented. A system consisting of particles interacting via configuration-dependent forces which become negligibly small whenever the mutual distances between the particles is very large is assumed. As they pass from the remote past to the remote future, it is assumed that the particles come together, react through the interacting forces, and scatter. This transition of the system from past to future is described. (M.C.G.)

25447 (ANL-6373) THEORETICAL REACTION CROSS SECTIONS FOR ALPHA PARTICLES WITH AN OPTICAL MODEL. J. R. Huizenga (Argonne National Lab., Ill.). and G. J. Igo (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1961. Contract W-31-109-eng-38. 28p.

The transmission coefficients T_l and total reaction cross sections σ_R for alpha particles from 0 to 46 Mev interacting with twenty target nuclei with atomic numbers from 10 to 92 are calculated with optical model program in which a previously determined complex nuclear potential is utilized. The dependence of the T_l values, and hence of σ_R, on the Woods-Saxon parameters is investigated as a function of projectile energy. The optical model reaction cross sections are compared with those derived from a square-well potential and a model which approximates the real optical model potential barrier by a parabola and makes use of the Hill-Wheeler penetration formula for a parabolic potential. (auth)

25448 (GEAP-3617) ABSORBER BURN-UP EXPERIMENT INTERIM REPORT. John L. Russell, Jr., Morton R. Carrothers, and Walter V. Mosgovoy (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Jan. 20, 1961. Contract AT(04-3)-189. 60p.

Experimental results are presented of pile oscillator measurements on irradiated samples of boron, cadmium, dysprosium, erbium, europium, gadolinium, lutetium, samarium, and silver–indium–cadmium. Preliminary theory-experiment correlations are included. The qualitative behavior of the cross sections of the various samples with exposure is as expected. The model used in the preliminary calculations of expected results is inadequate for quantitative comparison. (auth)

25449 (JINR-D-516) MEASUREMENT OF THE CORRELATION COEFFICIENT C_{nn} AT 90° AND AN ENERGY OF 315 MEV FOR THE ELASTIC PP-SCATTERING. I. M.

Vasilevskii (Vasilevsky), V. V. Vishnyakov, E. Iliescu, and A. A. Tyapkin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1960. 9p.

The spin correlation coefficient C_{nn} was measured for p-p scattering at 90° (c.m.s.) and 315 Mev and found to be 0.52 ± 0.20. Calibration experiments on the polarization of protons at 640 Mev gave C_{nn} = 0.7 ± 0.3. (D.L.C.)

25450 (JINR-D-719) DIFFRACTION πN-SCATTERING AND SPATIAL NUCLEON STRUCTURE. D. I. Blokhintsev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 11p.

A method for analyzing the π-N diffraction scattering is given. It is based on the notion of the effective π-N interaction potential. The application of this method to 6.8-Bev/c pion scattering pointed to the strong π-π interaction. (auth)

25451 (JINR-D-721) TOTAL CROSS-SECTIONS FOR K^+-PROTON INTERACTIONS. A. S. Vovenko, B. A. Kulakov, M. F. Likhachev, A. L. Lyubimov (Ljubimov), Y. (Ju.) Matulenko, I. A. Savin, E. (Ye.) V. Smirnov, V. S. Stavinskii, Yuin-chan Sui (Sui Yuin-chin), and Nai-sen Shzan (Shzan Nai-sen) (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 8p.

An investigation was made of the behavior of the total cross section for K^+-p interactions in the momentum range from 2.7 to 4.8 Bev/c. Positive particles from the synchrophasotron were analyzed according to their moments by the magnetic field of the accelerator. It was found that the total cross section rises from 15.0 ± 2.1 to 25.8 ± 2.7 in this momentum range. (M.C.G.)

25452 (JINR-E-539) ON THE DERIVATION OF EQUATIONS FROM THE MANDELSTAM REPRESENTATION. A. V. Efremov, V. A. Meshcheryakov, D. V. Shirkov, and H. Y. Tzu (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 6p.

A method for the derivation of integral equations for partial wave scattering amplitudes is discussed. The dependence of the imaginary part of the scattering amplitude on $\cos\theta = c$ was put into an explicit form using spectral representation. A general approach to the problem of deriving integral equations for low energy processes from the dispersion relation and unitary conditions is proposed. For deriving integral equations those angles were chosen for which the Legendre expansion fails only at the distant part of the unphysical region. This method was applied to π-π and π-n scattering. (M.C.G.)

25453 (LA-2525) THORIUM CROSS SECTIONS AND THEIR TEMPERATURE DEPENDENCE. Joseph J. Devaney, Leona O. Bordwell, and Ralph E. Anderson (Los Alamos Scientific Lab., N. Mex.). Apr. 1961. Contract W-7405-eng-36. 251p.

A Breit-Wigner analysis of thorium was folded into a Maxwellian velocity distribution to obtain total, scattering, and radiative capture cross sections for Th^{232} versus neutron energy from 0.0253 to 999 ev and for thorium temperatures of 0.0253 to 500 ev. The factor $[(m + M)/M]^2$ was omitted from the laboratory system form of the Breit-Wigner single level formula. (auth)

25454 (NP-10387) THE NUCLEAR PROPERTIES OF RHENIUM. Quarterly Technical Progress Report No. 6, March 8, 1961 through June 8, 1961. John A. Wethington, Jr. and R. A. Karam (Florida, Univ., Gainesville). Contract NOas 60-6021-c. 14p.

Carbon, iron, and rhenium slabs were subjected to beams of slightly degraded fission neutrons. An analysis of the pulse-height spectra for the interactions within the slabs indicated a common peak at 0.51 Mev. Methods for measuring elastic and inelastic scattering cross sections for fission neutrons, and for determining the γ-ray yield from inelastic scattering are discussed. A method for separating gamma and neutron responses in NaI(Tl) crystals is derived. (B.O.G.)

25455 (NP-10448) POLARIZATION IN NUCLEAR SCATTERING. Technical Report No. 1. Richard G. Allas (Washington Univ., St. Louis). July 1961. Contract AF49 (638)-843. 39p. (AFOSR-TN-965)

A nonrelativistic treatment is presented of polarization experiments, in an attempt to define the concept of polarization in a systematic way. The study is applied to a variety of particles and reactions, over large energy ranges. The physical bases of the mathematical formalisms are investigated. The scattering matrix is studied intensively. Uses of the optical model parametrizations are reviewed. Examples are shown of n and p scattering by U and Cu respectively. (T.F.H.)

25456 (ORNL-3080) AVERAGE ENERGY LOSS PER ION PAIR PRODUCED BY ALPHA PARTICLES IN BINARY GAS MIXTURES. T. D. Strickler (Oak Ridge National Lab., Tenn.). July 17, 1961. Contract W-7405-eng-26. 44p.

W_{ij}, the mean energy lost per ion pair produced by alpha particles in mixtures of i and j gases, was determined for a large number of binary mixtures. It was found that plotting W_{ij} vs Z''_{ij} $(= P_i/(P_i + f_{ij}P_j))$ gave straight lines for most mixtures and revealed the Jesse effect (decrease in W with impurity) where present. (D.L.C.)

25457 (PAN-221/I-A) MEASUREMENT OF THE MEAN LIFE OF THE FIRST EXCITED STATE OF Na^{23}. B. Ambrozy, A. Faudrowicz, A. Jasiński, J. Kownacki, H. Lancman, and J. Ludziejewski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1961. 10p.

The mean life of the first excited state of Na^{23} was measured using resonance fluorescence techniques. Ne^{23} obtained from $Ne^{22}(n,\gamma)Ne^{23}$ reaction by irradiation neon in the reactor was used as a source. The value of the mean life was found to be: $\tau = (1.5^{+0.3}_{-0.2}) \cdot 10^{-12}$ sec. (auth)

25458 (PR-P-47) PHYSICS DIVISION PROGRESS REPORT, JULY 1, 1960 TO SEPTEMBER 30, 1960. (Atomic Energy of Canada, Ltd. Chalk River Project, Chalk River, Ont.). 75p. (AECL-1142)

Nuclear Physics. The results of analysis of data on U^{233}, U^{235}, and Pu^{239} for the number of neutrons per fission fragment ν are given. A method of analysis of γ-γ correlation measurements for spin assignments is outlined, and results are presented for Ne^{20}, Mg^{24}, Mg^{26}, Si^{28}, Si^{30}, and S^{32}. The results of E2/M1 amplitude mixing ratio studies are given for Mg^{25}, Al^{27}, Si^{29}, and P^{31}. General Physics. The observations on the July 1959 cosmic-ray events are summarized. The K583.3 and L510.8 conversion lines in Pb^{208} from Tl^{208} decay were resolved with a $\pi\sqrt{2}$ β spectrometer. Conversion line spectra were examined for a large number of isotopes in order to see whether the K-line widths could be predicted. Relative E2 transition probabilities from the 2+ and 3+ gamma-vibrational levels in Gd^{154}, Gd^{156}, and Dy^{160} are discussed. The results of studies of the conversion line spectra of Ce^{143}, Ce^{144}, and Ba^{140} are given. The wall effect in internal gas proportional counters is discussed for Kr^{85} and C^{14}. The half life and branching ratio of K^{42} were measured. Research in detectors is outlined. Neutron Physics. Results are described for experiments on neutron scattering by water, liquid Ar, and solid He. Work on the crystal dynamics of Na and KBr is summarized. Error measurements in the determination of the deuteron

binding energy gave a corrected binding energy of 2227.0 ± 0.5 kev. The results of an experiment for measuring the electron asymmetry from neutron decay are described. Electronics. Development and construction of various electronic instruments are described. Some of the items treated are a CIR reactor control system, pulse amplifiers, pulse height analyzer, and kicksorter. Theoretical Physics. Various research projects are described, and reviews of topics in theoretical physics are presented. The results of analysis of heavy ion reaction data are described. Elastic scattering of C^{12} by C^{12} was studied. Computation programs are described. (D.L.C.)

25459 (TID-11807) NUCLEAR DECAY SCHEME STUDIES ON SHORT-LIVED NUCLIDES FROM THE (n,γ) AND (n, FISSION) REACTIONS. Morris Arnold Wahlgren (Michigan. Univ., Ann Arbor). Feb. 1961. Contract AT(11-1)-70. 143p.

A study was made of nuclear decay schemes, primarily of short-lived nuclides, utilizing the irradiation facilities of the Ford Nuclear Reactor at the University of Michigan. Multichannel pulse-height analysis was applied to the study of short-lived fission products and to a search for unreported isomeric transitions among the (n,γ) reaction products. Irradiation and handling techniques were developed and instrumental modifications made to facilitate the study of short-lived nuclides. The neutron flux and flux distribution at the irradiation position were measured. A simple and rapid separation of gaseous fission products into krypton and xenon fractions was developed. The primary gamma energies of 3.2-min Kr^{89}, 33 sec Kr^{90}, 1.2-min Rb^{91m}, 41-sec Xe^{139}, and 66-sec Cs^{140} were determined and relative gamma intensities measured. Maximum beta energy end-points were measured for Kr^{89}, Kr^{90}, Xe^{139}, Cs^{140}, and 9.5 min Cs^{139}, and lower limits established for the decay energies of these nuclides. The gamma rays of the daughter activities, 14.9-min Rb^{89}, 2.7-min Rb^{90}, and Cs^{139}, previously reported in the literature were verified. An upper limit of 2 minutes was established for the half-life of the fission product, Rh^{109}, by devising a chemical separation, requiring 6 min, giving decontamination factors of $>10^5$ from other elements. An isomeric level of Pt^{199} was detected and characterized by the (n,γ) reaction on normal and enriched platinum samples. The isomer decayed with a half-life of 14.1 ± 0.3 sec by emission of gamma rays of 32 ± 2 kev and 393 ± 2 kev energy. The thermal neutron cross-section for the formation of the isomer was 28 ± 3 mb. A long-lived isomer of Ag^{108} was detected in Ag^{110m} tracer sources sufficiently old that the masking 270 day Ag^{110m} had decayed out. The half-life of the isomer was found to be >5 years. 90% of the disintegrations proceeded by electron capture followed by a cascade of three gamma rays of 434-, 616-, and 722-kev energy, and 10% went by isomeric transition to 2.4-min Ag^{108}. New values were determined for the branching ratios in 2.4-min Ag^{108}. No unreported isomeric transitions, with half-lives in the range of 1 sec to 10 min, were detected in the (n,γ) reaction on ruthenium, palladium, mercury, rhenium, barium, lanthanum, cerium, praseodymium, samarium, europium, gadolinium, terbium, holmium, erbium, thulium, ytterbium, or lutetium. (auth)

25460 (TID-13127) NUCLEAR-CHARGE DISTRIBUTION IN LOW-ENERGY FISSION. Arthur C. Wahl, Robert L. Ferguson, David R. Nethaway, David E. Troutner, and Kurt Wolfsberg (Washington Univ., St. Louis). June 1961. Contract AT(11-1)-85. 76p.

Fractional cumulative yields determined for the thermal-neutron fission of U^{235} are: Kr^{83}, $0.075^{+0.010}_{-0.002}$; Kr^{84}, $0.015^{+0.005}_{-0.002}$; Kr^{85}, $(1.1^{+0.3}_{-0.1}) \times 10^{-3}$; Kr^{87}, $<10^{-5}$; Xe^{137}, 0.978 ± 0.003; and Xe^{138}, 0.956 ± 0.003. Fractional cumulative yields determined for the spontaneous fission of Cf^{252} are: Xe^{139}, 0.67 ± 0.01; Xe^{140}, 0.45 ± 0.01; Xe^{141}, 0.172 ± 0.005; and Xe^{144}, <0.007. Fractional independent yields determined for the thermal-neutron fission of U^{235} are: Sr^{91}, 0.07 ± 0.05; Nb^{95m}, $<4 \times 10^{-5}$; Nb^{96}, $(1.0 \pm 0.2) \times 10^{-4}$; Nb^{97}, $(1.7 \pm 0.8) \times 10^{-3}$; Cs^{136}, $(1.10 \pm 0.15) \times 10^{-3}$; Cs^{138}, 0.044 ± 0.003; Ba^{139}, $0.012^{+0.005}_{-0.003}$; Ba^{140}, 0.066 ± 0.026; Ba^{141}, 0.27 ± 0.08; La^{141}, 0.004 ± 0.002; La^{142}, 0.019 ± 0.005; and Ce^{143}, $(4.4 \pm 3.0) \times 10^{-3}$. Fractional independent yields determined for the thermal-neutron fission of U^{233} are: Nb^{95m}, $<3 \times 10^{-4}$; Nb^{96}, $(1.3 \pm 0.2) \times 10^{-3}$; and Nb^{97}, 0.011 ± 0.004. Fractional independent yields determined for the thermal-neutron fission of Pu^{239} are: Nb^{95m}, $<3 \times 10^{-4}$; Nb^{96}, $(7.7 \pm 1.0) \times 10^{-4}$; and Nb^{97}, 0.015 ± 0.004. The fractional independent yield of Cs^{136} from spontaneous fission of Cf^{252} is <0.01. Fission yields of 51-min Nb^{98} from thermal-neutron fission of U^{235}, U^{233}, and Pu^{239} were determined as 0.064 ± 0.012%, 0.20 ± 0.03%, and 0.20 ± 0.03%, respectively. Half-life values determined are: Rb^{91}, 72 ± 8 sec; Rb^{92}, <11 sec; Nb^{98}, 51 ± 3 min; Cs^{141}, 25 ± 3 sec; Cs^{142}, <8 sec; and Ba^{143}, 12 ± 2 sec. Kr^{97} and a reported 14-min isomer of Rb^{91} were not found among the fission products. (auth)

25461 (TID-13344) INTERACTION OF PHOTONS AND PARTICLES WITH NUCLEI. Technical Progress Report in Theoretical Physics, November 1, 1960—October 31, 1961. (University of Notre Dame, Notre Dame, Ind.). July 24, 1961. Contract AT(11-1)-427. 10p.

Progress in a research program on theoretical physics is reported. A study was made of Coulomb scattering of polarized electrons in which an analytical expression for the spin-dependent cross sections for this type of scattering valid to order $(\alpha Z)^4$ was developed. In other activities, the radiative corrections to the Mott scattering asymmetry function are being evaluated to reconcile theoretical and experimental values. By use of a modified Sommerfeld-Maue wave function for the electron and (initially) an exact muon K-shell, an accurate evaluation of the Coulomb field effects on the decay of a polarized muon from the K-shell of μ atoms was made. A relativistic scattering wave function which is valid to second order in the αZ for all electron velocities was obtained. The cross section for bremsstrahlung production at short wave limits of the spectrum was evaluated to terms of relative order $\alpha^2 Z^2$ for high energy incident electrons. An alternate form for the exact continuum state relativistic Coulomb wave function was developed which expresses the spin dependence in terms of the usual Dirac plane wave spinor. (J.R.D.)

25462 (WSEG-RM-19) ENERGY AND TIME BETA RAY SPECTRA OF FISSION PRODUCTS OF U^{235} BY FISSION NEUTRONS AND U^{238} BY 14 MEV NEUTRONS. Robert B. Heller (Weapons Systems Evaluation Group, Washington, D. C.). Feb. 16, 1961. 58p. (AD-254212)

A machine program was developed to calculate the beta ray spectra from fission products at various times after fission and their distribution by specific nuclides. Calculations were made for U^{238} fission by 14-Mev neutrons and U^{235} fission by fission neutrons. The results are plotted as beta rays per fission per energy interval vs kinetic energy, % total beta energy per isotope vs time, total beta activity vs time, and total beta activity per second vs kinetic energy. The results are compared with those of Cameron and King. (D.L.C.)

25463 (JPRS-7905) INVESTIGATION OF THE RUTHERFORD DISPERSION OF ALPHA PARTICLES ON

ATOMIC NUCLEI. Ferenc Illes. Translated from Fiz. Szemle, 10: 348-52(Nov. 1960). 12p.

The validity of the Rutherford dispersion formula is studied in the scattering of Po^{212} α particles by light and heavy nuclei (Al, Ag, and Au). The effects of variations in several of the parameters are shown. It is found that nuclear forces cause deviations from the Rutherford relation in the case of Al. (T.F.H.)

25464 (JPRS-9691) ON THE THEORY OF NUCLEAR FISSION. I. THE NUCLEAR FORCE INTERACTION BETWEEN FRAGMENTS. W. Brunner and Harry Paul. Translated from Ann. Physik (7) 6: 267-87(Sept. 1960). 23p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 5625.

25465 RELATIVE INTENSITIES OF GAMMA RAYS FROM THE REACTION $F^{19}(p,\alpha\gamma)O^{16}$. Lars Ask. Arkiv Fysik, 19: 219-28(1961). (In English)

The relative intensities of the 6.14, 6.92, and 7.12 Mev gamma rays were measured for proton energies up to 2.63 Mev. A three-crystal-pair spectrometer was used with an energy resolution of 4%, permitting the two 7 Mev components to be resolved. (auth)

25466 BETA-GAMMA DIRECTIONAL CORRELATION IN Rb^{86}. J. H. Hamilton, B.-G. Pettersson, and J. M. Hollander. Arkiv Fysik, 19: 249-57(1961). (In English)

The directional correlation of the once-forbidden, nonunique 700 kev beta group with the 1.08 Mev gamma-ray in the decay of Rb^{86} was measured as a function of beta energy from 100 to 600 kev. A magnetic lens spectrometer was used for the energy selection of the beta particles. The maximum anisotropy measured at 600 kev is A = 0.40, which is much higher than the value reported earlier by Stevenson and Deutsch. An analysis of the beta transition is made in terms of the "modified B_{ij} approximation." (auth)

25467 ANGULAR DISTRIBUTION OF THE NEUTRONS FROM THE REACTION $Li^7(p,n)Be^7$. Arne Nilsson (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 19: 289-301 (1961). (In English)

Distributions were measured at four proton energies between 2.7 and 3.5 Mev, at angles up to 150°, using a time-of-flight technique with photographic recording of oscilloscope tracks. The energy of the cyclotron-accelerated protons was varied by degrader foils. The detector efficiency was calibrated with the help of the $T(p,n)He^3$ reaction. Some comments on the energy precision are made in an appendix. (auth)

25468 A DETERMINATION OF THE K-CONVERSION COEFFICIENT OF THE 6.1 SEC M4 TRANSITION IN Pb^{203}. Lars Persson and Rune Stockendal (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 19: 303-7(1961). (In English)

The K-conversion coefficient of the 825.2 kev M4 transition in Pb^{203} was measured by comparing the K x-ray and gamma-ray intensities in the decay of the 6.1 sec isomeric state. The scintillation spectrum was measured with an improved technique in which two multichannel analyzers were utilized, one for the x rays, the other for the isomeric gamma ray. The resulting value of $\epsilon_K = 0.22 \pm 0.02$ is in good agreement with theory ($\beta_4 = 0.22$). (auth)

25469 K- AND L-ELECTRON CAPTURE PROBABILITIES AND THE DECAY ENERGY OF Pb^{203}. Lars Persson and Ziemowid Sujkowski (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 19: 309-22(1961). (In English)

K x-ray spectra in coincidence with the gamma rays from the first and the second excited states of Tl^{203} were studied using scintillation techniques and an isotope-separated sample. The L_I/K capture ratio was deduced and the decay energy calculated according to the theory of Brysk and Rose. The total electron capture decay energy was found to be 817^{+12}_{-10} kev. Single spectra of the L and K x rays were measured and their ratio compared with theory. The Coster-Kronig yield $f_{L_I L_{III}}$ was deduced. The half life of Pb^{203} was remeasured and found to be 52.1 ± 0.2 hr. The log ft values for the decay to the first and the second excited states were determined using known branching ratios. (auth)

25470 NUCLEAR SPECTROSCOPY OF MASS-SEPARATED NEUTRON-DEFICIENT TELLURIUM ISOTOPES. R. W. Fink, G. Andersson, and J. Kantele (Univ. of Uppsala and Univ. of Helsinki). Arkiv Fysik, 19: 323-51(1961). (In English)

The radioactive decay of five neutron-deficient activities of tellurium from irradiations of Sb with 90-140 Mev protons was investigated with magnetic and scintillation spectrometers, beta proportional counter, and alpha ionization chamber using mass-separated sources. The electron spectra and the gamma scintillation singles and coincidence spectra were interpreted in the form of tentative disintegration schemes to account for the decay modes of Te^{116} (2.50 ± 0.02 hours), Te^{117}(61 ± 2 minutes, measured spin 1/2), Te^{118}(6.00 ± 0.02 days), and Te^{119} isomers (15.9 ± 0.3 hours, measured spin 1/2, and 4.5 ± 0.3 days, measured spin 11/2). Two neutron-deficient Sb isotopes also were prepared by mass separation and their half lives confirmed: Sb^{115}(36 ± 3 minutes) and Sb^{116}(64 ± 4 minutes). From NH_4I targets irradiated with 145-180 Mev protons, a new Te activity was found with half life about 5-6 minutes, which might be Te^{115} or Te^{114}. A new carrier-free radiochemical separation technique requiring about 30 seconds is reported for preparing Te sources from the irradiated NH_4I targets. No isomer in Te^{117} having a half life greater than 15 minutes was detected, and in the case of the Te^{119} isomers, no transitions corresponding to the internal branch could be found, the two isomers apparently decaying independently to levels in antimony. (auth)

25471 MASS NUMBER ASSIGNMENTS AND ALPHA ACTIVITIES OF LIGHT POLONIUM ISOTOPES. Wilhelm Forsling and Torsten Alväger (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 19: 353-68(1961). (In English)

Light polonium isotopes were produced mainly by utilizing heavy ion bombardments. Mass number assignments of these nuclides were made by use of an electromagnetic isotope separator. The alpha activities of Po^{198}, Po^{199}, Po^{200}, Po^{201}, Po^{202}, Po^{203}, Po^{204}, Po^{205}, Po^{206}, Po^{208}, and Po^{210} were studied. (auth)

25472 ALPHA RADIOACTIVITIES FROM NUCLIDES IN THE ATOMIC NUMBER REGION 80–83. Wilhelm Forsling (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 19: 369-74(1961). (In English)

By bombardments of targets of tungsten, rhenium, osmium, and iridium with carbon ions in the Stockholm 225-cm cyclotron, a great number of light nuclides, mainly belonging to the elements mecury, thallium, lead, and bismuth, was produced. Possible alpha emitters were searched for and the results obtained hitherto are preliminarily reported. (auth)

25473 SOME CALCULATIONS WITH A PHENOMENOLOGICAL NUCLEAR POTENTIAL. Velimir Roglić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 1-5 (Mar. 1961). (In English)

Assuming the validity of a combination of the Majorana central and Wigner tensor potential of the square well type, calculations were performed in order to determine four constants of the interaction using the measured values of the binding energy and the quadrupole moment of deuteron as well as the singlet scattering length and the effective range. With the determined constants calculations were made of the D state of deuteron, the triplet scattering length and the effective range, as well as of the total cross section at 14.1, 17.9, and 28.4 Mev. (auth)

25474 ON THE APPLICATION OF DISPERSION FORMULA TO PHOTONUCLEAR REACTIONS. Zvonko Marić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 7-9(Mar. 1961). (In English)

The elastic scattering of γ rays by nuclei is discussed. Difficulties in applying the dispersion formula to the region of discrete resonances are pointed out. (auth)

25475 MEASUREMENT OF THE EXCITATION CURVE FOR REACTION $C^{12}(d,p)C^{13}$. Dimitrije M. Stanojević, Maria K. Jurić, and Božidar S. Maršićanin. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 11-14(Mar. 1961). (In English)

A relative yield of the ground state protons was determined for $C^{12}(d,p)C^{13}$ for deuteron bombarding energies between 1070 and 1170 kev at eight different laboratory angles. The existence of resonance was found to be within this range of deuteron energies at the investigated angles. (auth)

25476 THE SPECIFIC ALPHA ACTIVITY AND HALF-LIFE OF ^{233}U. D. S. Popplewell (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 14: 50-1 (Apr. 1961). (In English)

The specific α activity and the half life of U^{233} are measured. Thin films of U_3O_8 are α counted, with sample weights accurate to 0.01 mg and U^{233} percentage activities known to 0.01%. The half life is found as $(1.615 \pm 0.009) \cdot 10^5$ years, and the specific activity is $(2.109 \pm 0.012) \cdot 10^7$ dpm/mg. (T.F.H.)

25477 MEASUREMENTS OF SOME RESONANCE ACTIVATION INTEGRALS. R. Dahlberg, K. Jirlow, and E. Johansson (AB Atomenergi, Stockholm). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 14: 53-4(Apr. 1961). (In English)

The resonance activation integrals of Na, Mn, Co, Cu^{63}, Cu^{65}, and Mo^{98} are measured, by finding their cadmium ratios in a thermal neutron beam with a known spectrum. (T.F.H.)

25478 MANY-PARTICLE INTERACTION AND LEVEL SHIFT OF THE He ATOM. L. I. Podlubnii. Nauk. Zapiski, Odes. Derzhav. Pedagog. Inst., 23: 154-64(1959).

The role of three-particle interactions in the He atom is discussed. The effective potential energy of the three-particle interaction is obtained to a first non-vanishing approximation of the Feynman-Dyson perturbation theory. The levels' shift of the He atom resulting from this interaction must have a magnitude of the order of a few tenths of cm^{-1} and be small in comparison with the experimental errors. The estimation of the next approximations of the perturbation theory for the three-particle potential yields a shift value lesser by two orders; the final result was obtained by using numerical integration. (Referat. Zhur. Fiz., No. 7, 1960)

25479 ADJUSTMENT OF RELATIVE NUCLIDIC MASSES (I) $A \leqq 70$. F. Everling (Max-Planck-Institut für Chemie, Mainz), L. A. König, J. H. E. Mattauch, and A. H. Wapstra. Nuclear Phys., 25: 177-215(1961). (In English)

An outline is given of the general procedure used in the least squares computation of masses from all relevant measurements. The data available for the mass range $1 \leqq A \leqq 70$ are tabulated and discussed. (auth)

25480 SPALLATION REACTIONS OF THORIUM BY 150 AND 82 MEV PROTONS. M. Lefort, G. N. Simonoff, and X. Tarrago (Université, Paris). Nuclear Phys., 25: 216-47(1961). (In French)

Spallation reactions of thorium by 150 and 82 Mev protons were studied by radiochemical isolation of Pa, Th, Ac, and Ra isotopes and measurements of absolute cross sections. Calculations were made for comparison, by assuming a model of nuclear reactions by direct interaction and neutron evaporation (Serber-Jackson). Fission-evaporation competition at each step was assumed. The agreement is very satisfactory for (p, pxn) reactions. However, experimental values are nearly twice those calculated for radium and actinium. Several reasons are discussed in order to explain this discrepancy. Direct interaction occurs also for alpha fragments, deuterons, and tritons. Cross sections for alpha particle and triton production were measured at various energies. The formation of tritium is explained in terms of indirect pick-up. (auth)

25481 THE NEUTRON DEFICIENT IRIDIUM ISOTOPES Ir^{182}, Ir^{183}, AND Ir^{184}. R. M. Diamond, J. M. Hollander, D. J. Horen, and R. A. Naumann (Univ. of California, Berkeley). Nuclear Phys., 25: 248-58(1961). (In English)

The new neutron-deficient iridium isotopes Ir^{182}, Ir^{183}, and Ir^{184} were produced by irradiations with the Berkeley heavy-ion linear accelerator. By means of timed chemical separations, NaI scintillation spectrometers, and proportional counters, half lives were determined as follows: Ir^{182}, 15 ± 1 min; Ir^{183}, 55 ± 7 min; Ir^{184}, 3.2 ± 0.2 hr. The gamma spectra of Ir^{182} and Ir^{184} are very complex, each extending above 4 Mev. Positon branches are also seen in both isotopes. Studies of the gamma spectra indicate that the energies of the first and second excited states of Os^{182} are slightly higher than the corresponding states in Os^{184}. These data suggest that there is a maximum in the moment of inertia at Os^{184}. (auth)

25482 THE ELASTIC SCATTERING OF 29 MEV ^{3}He-PARTICLES BY Cl, Kr, AND Xe. J. Aguilar (Univ. of Valencia, Spain), A. García, J. B. A. England, P. E. Hodgson, and W. T. Toner. Nuclear Phys., 25: 259-65(1961). (In English)

Angular distributions for the scattering of 29 Mev He^3 particles by Cl, Kr, and Xe were measured using a photographic plate method. Absolute differential cross sections for elastic scattering are given in the center-of-mass system in the angular range 14° to 80°. The experimental results are analyzed in terms of the optical model of the interaction and best fit parameters of this model are obtained. (auth)

25483 ENERGY LEVELS OF EVEN NUCLEI ON THE HYDRODYNAMICAL MODEL WITH VIBRATION-ROTATION INTERACTION. E. D. Klema, C. A. Mallmann, and P. Day (Argonne National Lab., Ill.). Nuclear Phys., 25: 266-77 (1961). (In English)

The Davydov and Chaban model for even nuclei, in which the beta-vibration-rotation interaction is taken into account exactly, was used to calculate the excited states of these nuclei. The calculated energies were compared with experimental data, special attention being paid to nuclei with known 0^+ excited levels. Where possible, comparison was made

also with the correlation of experimental data by means of the perturbation approach of Mallmann and Kerman and of the Bohr-Mottelson model. (auth)

25484 THE COMPARISON OF d-SHELL NUCLEI WITH THE NILSSON MODEL. L. L. Green, J. C. Willmott, and G. Kaye (Univ. of Liverpool). Nuclear Phys. 25: 278-81 (1961). (In English)

The effects of the isobaric spin and of the μl^2 term in the harmonic oscillator potential on the energy level spacings of the distorted oscillator potential are discussed. (auth)

25485 THE $B^{10}(d,n)C^{11}$ REACTION. A. N. James (Cavendish Lab., Cambridge, Eng.), A. T. G. Ferguson, and C. M. P. Johnson. Nuclear Phys., 25: 282-91(1961). (In English)

Neutron groups from the reaction $B^{10}(d,n)C^{11}$ were studied at deuteron energies of 1, 2, 3, and 4 Mev using time-of-flight techniques. The results are compared with those for the $B^{10}(d,p)B^{11}$ reaction and with Butler stripping theory for the intermediate coupling shell model. (auth)

25486 STUDY OF GAMMA TRANSITIONS AND AUGER ELECTRONS OF Eu^{153}. E. Monnand and A. Moussa (Institut de Physique Nucléaire, Lyon). Nuclear Phys., 25: 292-306(1961). (In French)

A study of the low-energy conversion spectrum of Sm^{153} β decay was carried out with an iron-free double focusing spectrometer. The mixing ratios E2/M1 were determined by analysis of the L conversion lines for the 70, 84, and 103 kev transitions. A 19 kev (E2) transition was revealed. The auger K and L electrons were studied and the K fluorescence yield measured. (auth)

25487 NUCLEAR POLARIZATION OF THE TRITIUM, HELIUM-3, AND HELIUM-4 MESIC ATOMS. C. Joachain (Université Libre, Brussels). Nuclear Phys., 25: 317-27(1961). (In French)

The energy-shift due to polarization of the H^3, He^3, and He^4 nuclei by a bound μ meson was evaluated. This effect is smaller than the energy-shift caused by the finite extension of the nucleus. There is no compensation as in the deuteron case. (auth)

25488 INTERNAL BREMSSTRAHLUNG IN $0^- \rightarrow 0^+$ BETA-TRANSITIONS. František Janouch (Nuclear Research Inst., Czechoslovak Academy of Sciences, Prague). Nuclear Phys., 25: 328-32(1961). (In English)

Internal bremsstrahlung accompanying a $0^- \rightarrow 0^+$ β transition is considered. It is shown that experimental investigations of the energy dependence of the degree of circular polarization of the internal bremsstrahlung quanta would allow the determination of the possible role of pseudoscalar interaction in nuclear β decay. (auth)

25489 ON THE THEORY OF COLLECTIVE ROTATIONS. Shinzo Nakai and Muneo Sasaki (Tokyo Metropolitan Univ.). Nuclear Phys., 25: 333-47(1961). (In English)

An analysis is made of descriptions of collective rotations of many-particle systems. Emphasis is laid upon the analysis of the flow pattern function generated when the system is set rotating. Some results of recent investigations devoted to the problem of the moment of inertia are also discussed. The essential point of the approach consists in calculating the flow pattern function subject to a constraint. This constraint equation, in simple cases, coincides with that of Tomonaga which was employed to define the canonical momentum describing incompressible deformation. A comparison is made with work based upon Tomonaga's theory of collective motion. The outcome of the present work will throw light on the method of evaluating the moment of inertia and, in particular, on the question of why interactions leading to superfluidity could appreciably change the rigid moment. (auth)

25490 THE GYROMAGNETIC RATIO OF THE 155 keV-ROTATIONAL LEVEL IN Os^{188}. E. Karlsson, C.-A. Lerjefors, and E. Matthias (Univ. of Uppsala). Nuclear Phys., 25: 385-403(1961). (In English)

Using a 4-channel coincidence apparatus, the influence of an external magnetic field on the angular correlation of the 931−155 kev cascade in Os^{188} was investigated. The strength of the magnetic interaction was found to be $|\omega_L \tau_N| = 0.0423 \pm 0.0034$ rad for a magnetic field of ±29200 G. Averaging the results of all lifetime determinations, $T_{1/2} = (5.8 \pm 0.5)10^{-10}$ s, giving $g_R = +0.36 \pm 0.04$ for the gyromagnetic ratio of the 155-kev rotational state. This result was derived under the assumption that no other perturbations were present in the liquid source used. This assumption is supported by present measurements as well as earlier determinations of the angular correlation coefficients of the 0−2−0-cascade. The result is in agreement with recent calculations based on the superconductor theory of the nucleus. (auth)

25491 THE GYROMAGNETIC RATIO OF THE 137 keV ROTATIONAL LEVEL IN Os^{186}. C.-A. Lerjefors, E. Matthias, and E. Karlsson (Univ. of Uppsala). Nuclear Phys., 25: 404-8(1961). (In English)

Using a 4-channel coincidence apparatus, the influence of an external magnetic field on the angular correlation of the 631−137 kev cascade in Os^{186} was investigated. The strength of the magnetic interaction was $|\omega_L \tau_N| = 0.043 \pm 0.010$ rad for a magnetic field of ±29200 gauss. Averaging the result of all lifetime determinations, $T_{1/2} = (7.0 \pm 0.9) \times 10^{-10}$ s. This gives $g_R = +0.30 \pm 0.08$ for the gyromagnetic ratio of the 137 kev rotational state. There is no evidence for the existence of internal perturbations in the liquid source used. (auth)

25492 THE REACTION $^{28}Si(p,\gamma)^{29}P$. K. J. Van Oostrum (Technische Hogeschool, Delft, Netherlands), N. Hazewindus, A. H. Wapstra, J. W. Olness, and J. L. Parker. Nuclear Phys., 25: 409-20(1961). (In English)

The level structure of P^{29} was investigated with the reaction $Si^{28}(p,\gamma)P^{29}$ for proton energies between 0.3 and 2.3 Mev. Levels of P^{29} at 3.09, 4.34, and 4.76 Mev were excited with (p,γ) resonances at proton energies of 0.371, 1.65, and 2.09 Mev, respectively. The strength of a γ resonance expected for excitation of a 3.49 Mev level in P^{29} was derived to be less than 5×10^{-4} ev. This low value is attributed to K-forbiddenness of the gamma decay of this level. Gamma rays from the 0.371 Mev resonance lead to levels at 1.95 and 1.37 Mev; those from the 1.65 Mev resonance lead to the ground state and, rather weakly, to the 1.37 Mev state; gamma rays from the 2.09 Mev resonance lead to the ground state only. Angular distributions are in agreement with the following spin assignments for the levels of P^{29}: 1.37 Mev ($^3/_2$), 1.95 Mev ($^5/_2$), 3.09 Mev ($^5/_2$), 4.34 Mev ($^3/_2$), and 4.76 Mev ($^1/_2$). The excited states found in these experiments are assigned to rotational bands based on Nilsson orbits 8, 9, 10, 11, and 16. (auth)

25493 NUCLEAR ENERGY LEVELS OF N^{16}. M. G. Silbert, Nelson Jarmie, and Darryl B. Smith (Los Alamos Scientific Lab., N. Mex.). Nuclear Phys., 25: 438-42 (1961). (In English)

Thirteen energy levels of N^{16} were determined in the range of excitation from 0 to 5.6 Mev by a high resolution study of the proton spectrum from $N^{14}(t,p)N^{16}$. Levels above the well-known ground state quartet are found at 3.340, 3.506, 3.956, 4.318, 4.392, 4.773, 5.059, 5.141, 5.230, and 5.526 Mev. These energies were assigned standard devia-

tions of from 10 to 25 kev. Level widths and reaction cross sections are also reported. The results are compared with previous experiments. (auth)

25494 THE TWO-STAGE NUCLEAR REACTION $N^{14}(t,n)O^{16*}(p)N^{15}$. Nelson Jarmie, M. G. Silbert, and Darryl B. Smith (Los Alamos Scientific Lab., N. Mex.). Nuclear Phys., 25: 443-6(1961). (In English)

A remarkably clear example of a two-stage nuclear reaction has been observed. Broad, steep-sided proton groups, observed during the bombardment of nitrogen by tritons, were ascribed to the process $N^{14}(t,n)O^{16*}(p)N^{15}$. It is notable that this reaction appears to proceed by way of particular sharp states in O^{16} at an excitation of about 15 Mev. (auth)

25495 ON THE LIMIT RULE OF CHARACTERISTIC LEVEL SPACINGS FOR A RANDOM MATRIX. Michel Gaudin (Centre d'Etudes Nucléaires, Saclay, France). Nuclear Phys., 25: 447-58(1961). (In French)

The distribution function of the level spacings for a random matrix in the limit of large dimensions is expressed by means of a rapidly converging infinite product which has been used for a numerical calculation. Comparison with Wigner's hypothesis gives a very good agreement. (auth)

25496 MULTIPLE COULOMB EXCITATIONS OF VIBRATIONAL NUCLEI. D. W. Robinson (Institut für Theoretische Physik, Zurich). Nuclear Phys., 25: 459-71 (1961). (In English)

An analysis is made of the multiple Coulomb excitation of vibrational nuclei taking into account both one-phonon and two-phonon processes. Some of the results of Alder and Winther concerning the one-phonon transitions are rederived together with some new results concerning the excitation of the triplet of substates forming the second excited state. It is shown that the weak two-phonon processes can affect the excitation probabilities through interference with the strong one-phonon processes. The interference is destructive at energies for which a particular state is being primarily excited and constructive at higher energies for which the state is being de-excited in favor of higher states. (auth)

25497 THE ELECTRON-NEUTRINO ANGULAR CORRELATION IN BETA DECAY OF HELIUM 6. B. W. Ridley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys., 25: 483-501(1961). (In English)

The electron-neutrino angular correlation in He^6 decay was determined by measuring the distribution of electron energies and recoil velocities without selection of angle. The correlation parameter α was found to be -0.353, confirming current belief that the Gamow-Teller interaction is axial vector. The maximum admixture of a tensor interaction is given by $|C_T|^2/|C_A|^2 < 0.08$. (auth)

25498 MONTE CARLO CALCULATION OF NEUTRON EVAPORATION; EXCITATION ENERGY DEPENDENCE OF NUCLEAR LEVEL DENSITY. R. Vandenbosch, J. R. Huizenga, W. F. Miller, and E. M. Keberle (Argonne National Lab., Ill.). Nuclear Phys., 25: 511-21(1961). (In English)

Experimental excitation function data in the heavy element region were analyzed by a Monte Carlo technique to investigate the dependence of the nuclear level density on excitation energy. The analysis supports the prediction of the completely degenerate Fermi gas model that the nuclear temperature varies as the square root of the excitation energy. The value of the level density parameter a deduced from the experimental data is changed significantly when shell and pairing effects are taken into account by displacement of the characteristic energy surface from which the excitation energy is measured. (auth)

25499 ON THE DEGENERACY OF THE SUPERCONDUCTIVE STATE. P. Mittelstaedt (Max-Planck-Institut für Physik und Astrophysik, Munich). Nuclear Phys., 25: 522-8(1961). (In English)

The ground state of the BCS theory is investigated in the limit of infinite volume. Using a theorem of Bogolyubov it is shown that the energy density of the ground state can be obtained exactly using either states degenerate with respect to the gauge transformation or a state with a fixed number of particles. (auth)

25500 RELATIVE INELASTICITY AND ANISOTROPY OF PROTON INTERACTIONS AT 9 AND 23.5 Gev. E. M. Friedländer, M. Marcu, and M. Spîrchez (Inst. of Atomic Physics, Bucharest). Phys. Rev. Letters, 7: 25-7(July 1, 1961).

The inelasticity and forward-backward peaking of nucleon-proton interactions are measured at 9 and 23.5 Bev. The inelasticity decreases and the anisotropy increases with increasing energy. (T.F.H.)

25501 SCATTERING OF 915-Mev α PARTICLES FROM CARBON AND HELIUM: DIRECT EVIDENCE FOR α-PARTICLE CLUSTERING IN NUCLEI. Terence J. Gooding and George Igo (Univ. of California, Berkeley). Phys. Rev. Letters, 7: 28-30(July 1, 1961).

The reaction $C^{12}(\alpha,2\alpha)Be^8$ is studied at 915 Mev, in an attempt to show that the reaction proceeds via a direct collision between the incident α particle and an α particle cluster within the nucleus. The data are compared with data from the reaction $He^4(\alpha,2\alpha)$, in order to find the probability that the direct α-α collision is the actual process by which the reaction is carried on. (T.F.H.)

25502 NUCLEAR DE-EXCITATION FOLLOWING MUON CAPTURE AND THE BOUND MUON DECAY ANOMALY. Frank Chilton (Univ. of Washington, Seattle). Phys. Rev. Letters, 7: 31-4(July 1, 1961).

The rate of the μ^- meson decay reaction $\mu^- \rightarrow e^- + \nu + \bar{\nu}$ in the Coulomb field of a nucleus is studied. It is suggested that discrepancies between the observed and theoretical rates may be caused by the unwanted detection of the μ^- capture reaction $\mu^- + p \rightarrow n + \nu$. The neutron from this reaction can produce gamma radiation by various processes, and the gamma radiation can produce electrons either by pair production or by the Compton effect. Experimental methods for testing the existence of this mechanism are proposed. (T.F.H.)

25503 HYPERFINE STRUCTURE OF THE LEVEL $5^2P_{1/2}$ OF POTASSIUM 39. W. N. Fox and G. W. Series (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 77: 1141-6(June 1, 1961).

The hyperfine structure of the $5^2P_{1/2}$ level of K^{39} is measured by techniques of optical-radio-frequency double resonance. The magnetic interaction constant $a_{1/2}$ is found to be 8.99 ± 0.15 Mc which leads to the value 4.56 ± 0.3 for the ratio $a_{1/2}/a_{3/2}$. This is significantly lower than the value 5.08 that is predicted by theory. The measured value of the g-factor is 0.665 ± 0.003. (auth)

25504 ANGULAR CORRELATIONS IN THE REACTIONS $^{18}O(\alpha,n\gamma)^{21}Ne$ AND $^{22}Ne(\alpha,n\gamma)^{25}Mg$. W. M. Deuchars and D. Dandy (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 77: 1197-1204(June 1, 1961).

The angular correlation of the gamma radiation from the first excited state of Ne^{21}, in coincidence with neutrons, is

studied using an axially symmetric neutron counter at 0° to the incident beam direction. Results for Ne^{21} together with the published lifetime measurement of the first excited state of Ne^{21}, show that the amplitude of the electric quadrupole radiation divided by the amplitude of the magnetic dipole radiation is $0.004 \leq \delta \leq 0.03$. The gamma radiation from the first excited state of Mg^{25}, in coincidence with neutrons, is also observed but no detailed study of the angular correlation is made. (auth)

25505 ORBITAL ELECTRON CAPTURE RATIO AND BETA SPECTRUM OF ^{204}Tl. B. R. Joshi (Glasgow Univ.). Proc. Phys. Soc. (London), 77: 1205-9(June 1, 1961).

A direct measurement of the L/K electron capture ratio is made for Tl^{204}. An internal source scintillation counter technique is used. A crystal is grown containing Tl^{204}, and this crystal is totally enclosed in a well-type scintillation crystal. The experimental ratio obtained for this unique first forbidden transition ($\Delta J = 2$) is 0.42 ± 0.05. This value may be compared with the ratio 0.45 ± 0.05 calculated from the electron capture transition energy. In addition, information is obtained on the β^- decay branch. The low energy end of the Fermi-Kurie plot of the β^- spectrum, after application of an exact shape correction factor, deviates slightly downwards from a straight line. (auth)

25506 AN ENERGY LEVEL OF ^{24}Mg AT 6.44 MeV EXCITATION. S. Hinds, R. Middleton, and A. E. Litherland (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 77: 1210-11(June 1, 1961).

The energy levels of Mg^{24} below 12 Mev are investigated, using the reaction $C^{12}(O^{16},\alpha)Mg^{24}$. Evidence is found for energy levels at 6.44, 11.08, and 11.73 Mev, in addition to the established levels. (T.F.H.)

25507 THE SPIN OF A NEW LEVEL IN ^{24}Mg. C. Broude and H. E. Gove (Atomic Energy of Canada Ltd., Chalk River, Ont.). Proc. Phys. Soc. (London), 77: 1211-14(June 1, 1961).

An energy level at 6.44 Mev in Mg^{24} is postulated to account for a 5.05-1.37 Mev gamma cascade observed in the inelastic scattering of protons from Mg^{24}. The spin of this level is measured to be 0, and the spins of established levels at 5.44 and 6.01 Mev are found to be 3+ and 4+ respectively. (T.F.H.)

25508 THE THRESHOLD OF THE $^{12}C(^3He,n)^{14}O$ REACTION. J. H. Towle and B. E. F. Macefield (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 1217-19(June 1, 1961).

Using a proton resonance magnetometer, a threshold energy of 1434.8 ± 1.6 kev is found for the reaction $C^{12}(He^3,n)O^{14}$. (T.F.H.)

25509 THE DETERMINATION OF THE HALF LIFE OF RaC′. T. Dobrowolski and J. Young (Univ. of Birmingham, Eng.). Proc. Phys. Soc. (London), 77: 1219-20(June 1, 1961).

The half life of Po^{214} is measured by considering the chain $Bi^{214} \xrightarrow{\beta^-} Po^{214} \xrightarrow{\alpha} Pb^{210}$. The time delay between the β^- and the α is measured, giving a half life of 164.3 ± 1.8 μsec. (T.F.H.)

25510 CONSIDERATION OF EXCHANGE IN IONIZATION. R. Peterkop (Inst. of Physics, Latvian Academy of Sciences, Riga). Proc. Phys. Soc. (London), 77: 1220-2 (June 1, 1961).

Exchange effects are considered in the excitation or ionization of atoms by electron bombardment. It is assumed that the incident electron is not captured by the atom. It is shown that exchange effects in the ionization process may be regarded as simple interference effects. The treatment is extended to include multiple ionization. The electron-hydrogen atom collision is given as an example. (T.F.H.)

25511 ISOMERISM OF ATOMIC NUCLEI. L. I. Rusinov. Uspekhi Fiz. Nauk, 73: 615-30(Apr. 1961).

The discovery of nuclear isomerism by Kurchatov is described and its history related. A review of the investigation of nuclear structure by the study of isomerism is presented. Spherical nuclei are discussed first, and a brief shell model treatment is outlined. Experimental data on lifetimes and multipolarities of many isomeric transitions are shown graphically, to bring out the systematics of this process. Deformed nuclei in the rare earth region are discussed in the light of the collective model, and again experimental data are presented, but the theory is only alluded to. Finally, the method of producing metastable states of very high spin by means of heavy ion bombardment is described. (TTT)

25512 SOME PROBLEMS CONCERNING THE ISOMERISM OF ATOMIC NUCLEI. V. I. Goldanskii and L. K. Peker. Uspekhi Fiz. Nauk, 73: 631-53(Apr. 1961). (In Russian)

After an introduction mentioning the discovery of nuclear isomerism by Kurchatov, several specialized problems in this field are treated. 1. The isomerism in the millisecond region: Experimental data for many nuclides are given in the form of disintegration schemes. Shell model and Nilsson model level diagrams for spherical and deformed nuclei, respectively, are shown. 2. Isomerism of odd-odd nuclei: Experimental data are presented, and some general conclusions concerning these nuclei are drawn. 3. Configuration isomerism: In this section relatively low-lying isomeric states of very high spin, e.g., $2^1/_2$ are postulated. Their production by direct reactions in heavy ion bombardment is examined. This method is shown to present a real possibility for the production of very high spin metastable states. (TTT)

25513 SPONTANEOUS NUCLEAR FISSION. K. A. Petrzhak and G. N. Flerov. Uspekhi Fiz. Nauk, 73: 655-83(Apr. 1961). (In Russian)

The history of the early work on spontaneous fission in Kurchatov's laboratory is related. Further, results are reviewed on the systematics of spontaneously fissioning nuclides such as the well-known plots of half-life vs. Z^2/A for even-even nuclei, and of half-life vs. neutron number. Mass distributions of fission fragments are given for U^{238}, Cm^{242}, and Cf^{252}. The theory of spontaneous fission is reviewed from the point of view of a deformable liquid drop. Spontaneous fission applications in astrophysics and geophysics are given. The Cf^{254} spontaneous fission half-life in supernovae is discussed, as is the presence of fission produced xenon in old rare-earth minerals. A discussion of transuranic elements is given, in which it is pointed out that spontaneous fission of very heavy elements is responsible for the limit of the atomic table. Spontaneous fission competes successfully with other modes of decay and makes production of very heavy elements difficult. (TTT)

Particle Accelerators

25514 (BNL-5492) ZENER REFERENCE VOLTAGE FOR AGS EXPERIMENTAL MAGNET POWER. Internal Report. J. G. Cottingham (Brookhaven National Lab., Upton, N. Y.). Feb. 5, 1960. 7p. (ADD-JGC-17)

A comparison is made of several possible candidates for the reference voltage source in the regulator system for

AGS Experimental Magnet Power. A discussion is given for the properties of the Zener diodes which caused them to be chosen over the other candidates considered. Graphical representations are included for the properties of the Zener diodes. (B.O.G.)

25515 (BNL-5497) EXTRACTION AND FOCUSING OF BEAM III. G. Chadwick (Brookhaven National Lab., Upton, N. Y.). Dec. 16, 1960. 4p.

A summary is included of the characteristics of the third external proton beam extracted from the cosmotron. The beam was brought to a first focus at energies of 1.35, 2.06, and 2.87 Bev. The parameters found optimal in extracting and focusing the beam are tabulated. (B.O.G.)

25516 (MURA-602) RELAXATION CALCULATION OF MAGNETIC FIELDS PRODUCED BY DISTRIBUTED CURRENTS IN PRESENCE OF IRON WITH A VARIABLE PERMEABILITY. S. C. Snowdon and R. S. Christian (Midwestern Universities Research Assn., Madison, Wis.). Jan. 16, 1961. Contract AT(11-1)-384. 18p.

The solutions obtained previously for the magnetic field produced by a spiral sector FFAG magnet in which the pole face windings are distributed in spiral and radial grooves were extended to include the effects of a finite variable permeability in the iron. A unified method is presented for the construction of the algorisms. The cases treated are sufficiently general that both radial gaps as well as radial return current slots are included. This allows the potential to be graded along the spiral poles with a grading distance equal to the distance between radial return slots and with a grading distance equal to the distance between the radial gaps. (auth)

25517 (MURA-611) TIME MODES OF A COASTING BEAM IN A SIMPLE PERTURBATION APPROACH. W. N. Wong (Midwestern Universities Research Assn., Madison, Wis.). Feb. 27, 1961. Contract AT(11-1)-384. 29p.

A simple linear perturbation treatment was attempted in the solution of the coupled Maxwell equations and Boltzmann's equation of the distribution function pertaining to a charged coasting beam of weak intensity confined to a donut-like space of metallic boundaries. These coupled equations were cast into a single integral equation and treated as an eigenvalue problem to determine the various time modes. Difficulties encountered at various stages of approximation are discussed. (auth)

25518 (ORNL-3158) RESIDUAL RADIATION OF THE LRL 184-INCH CYCLOTRON. R. W. Boom, K. S. Toth, and A. Zucker (Oak Ridge National Lab., Tenn.). July 12, 1961. Contract W-7405-eng-26. 16p.

Residual radioactivity at the Lawrence Radiation Laboratory 184-Inch Cyclotron was measured during November 1960. The study was conducted along three principal lines: 1) general survey of radiation levels in the cyclotron vault, 2) activation of foils placed near the cyclotron, and (3) gamma-ray spectra of the cyclotron gap region, including flee structure. Initial radiation levels were less than 8 r/hr which dropped to about 10 mr/hr after 48 hr. The observed activities induced in copper foils were Cu^{64} and Co^{58}; in iron foils, Mn^{52}, Mn^{54}, and Mn^{56}; in aluminum foils, Na^{24}. The gamma-ray spectra from the gap region included two intense long-lived peaks, at 510 and 810 kev, caused principally by Co^{58}. (auth)

25519 (SCTM-155-61(14)) ČERENKOV RADIATION FROM AN ELECTRON TRAVELING IN A CIRCLE THROUGH A DIELECTRIC MEDIUM. J. J. Newman (Sandia Corp., Albuquerque, N. Mex.). May 1961. 37p.

The theoretical problem of determining the Cherenkov radiation from an electron traveling in a circle through a medium was advanced and the fields and resultant radiation from such a geometry were determined. A solution was achieved by a transformation of the fields as determined by Frank and Tamm. This transformation resulted in a solution as a summation of eigenfrequencies each separated by the frequency of the electron's periodic motion. The radiation expression derived by this transformation method approaches the Frank and Tamm radiation expression in the limit. (auth)

25520 (TID-13182) PERFORMANCE ESTIMATES FOR INJECTOR CYCLOTRONS. H. G. Blosser and M. M. Gordon (Michigan State Univ., East Lansing). May 20, 1961. 46p.

Available evidence on performance to be expected from injector cyclotrons is collected and reviewed. Estimates are made of current, spot size, angular divergence, energy spread, and duty cycle for the extracted beam of possible 40 and 200 Mev injector cyclotrons. (auth)

25521 (UCRL-9416) PRELIMINARY STUDIES ON BEAM PROGRAMMING IN A CYCLOTRON. Hans A. Willax (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 30, 1960. Contract W-7405-eng-48. 41p.

In order to investigate the influence of the electric field on the particle motion in the center of a cyclotron, a geometric method for approximate orbit construction was used in combination with analog measurements of the electric field. The results show that perturbations of the electric field, as induced by the ion source and the ion-extraction device, can be of important influence on the beam behavior and the beam quality in a cyclotron. Possibilities for "Beam Programming" are discussed under these aspects. (auth)

25522 (NP-tr-699) EXPERIENCE ACCUMULATED IN THE DEVELOPMENT OF INDUSTRIAL MODELS OF ELECTROSTATIC GENERATORS. I. F. Malyshev, F. G. Zheleznikov, and G. Ya. Roshal'. Translated from p.224-56 of Elektrostaticheskiye Generatory, 1959. 40p.

The design, construction, and operation of the Russian EG-2.5 (up to 2.5 Mev) and EG-5-1 (4 to 5 Mev) electrostatic generators are discussed in detail. (D.L.C.)

25523 ACCELERATORS WITH A GENERAL MAGNETIC FIELD. G. Parzen (Midwestern Universities Research Association, Madison, Wis.). Ann. Phys. (N. Y.), 15: 22-43(July 1961).

The linear motion of a particle moving in an accelerator having a general magnetic field is investigated. A solution is found which is valid for a wide class of accelerators, including the AG synchrotron, FFAG accelerators, and the fixed-frequency cyclotron. Results are given for the equilibrium orbit, the betatron oscillation frequencies, the betatron oscillations and other linear orbit properties. (auth)

25524 BUNCHING PHENOMENA DURING ELECTRON INJECTION INTO THE BETATRON. I. EXPERIMENTS. M. Seidl (Inst. of Vacuum Electronics, Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys., B11: 390-405(1961). (In English)

Under suitable conditions, electrons injected into the betatron give rise to high-frequency oscillations. An experimental investigation of the properties of the oscillations is presented. The oscillations are caused by azimuthal bunching of the injected or captured electrons. The bunching is caused by a regenerative amplification of space-charge density fluctuations. The amplification is produced by the "negative mass instability" mechanism. Bunching

of the injected electrons is the primary cause of the capture of electrons injected into a static or slowly varying magnetic field. Bunching of the captured electrons represents a limitation in the magnitude of the capturable charge. (auth)

25525 PRINCIPLES OF CYCLIC PARTICLE ACCELERATORS. John J. Livingood. Princeton, N. J., D. Van Nostrand Company, Inc., 1961. 400p. $10.75.

The cyclic particle accelerators—cyclotrons, synchrocyclotrons, synchrotrons, betatrons, microtrons, linear accelerators, and isochronous and stochastic machines—are described to show their principles of operation, similarities, differences, and limitations. Orbit stability problems are discussed in terms of weak-, strong-, and sector-focusing techniques and with calculations of the frequencies of the associated oscillations of the orbits. The important concepts of momentum compaction, phase stability, and synchrotron oscillations are described and analyzed, and problems of injection and ejection are considered. (N.W.R.)

Plasma Physics and Thermonuclear Processes

25526 (AD-250956) GENERATION AND PROPERTIES OF THERMAL PLASMAS. (Reference Bibliography). Jean E. Britton and Thomas B. Reed (Massachusetts Inst. of Tech., Lexington. Lincoln Lab.). Nov. 28, 1960. 6p.

References covering the literature of thermal plasmas in a state of equilibrium, at a pressure of 1 bar, in the temperature range from 7,000 to 50,000°K are presented. Report literature is included as well as books and periodicals. Fifty four items which appeared between 1955 and June 1960 are listed. (M.C.G.)

25527 (AFOSR-431) THE ONE-DIMENSIONAL PLASMA. Technical Report No. 2. Stephen Prager (Minnesota. Univ., Minneapolis). Mar. 17, 1961. Contract AF49(638)-720. 36p. (AD-254140)

The interaction of two charges in one dimension corresponds to the three-dimensional interaction of two uniformly charged parallel plates, that is, the potential is Λ- or V-shaped depending on whether the charges are of like or unlike sign. The partition function for an electrically neutral system of such charges can be obtained rigorously, without recourse to any approximations. The resulting thermodynamic functions agree with those predicted by the one-dimensional Debye-Hückel theory in the limit of high pressures, but considerable deviations appear as the pressure is reduced. At very low pressures, the system behaves as though made up of neutral molecules. The effect of an external electrostatic field is discussed, and the treatment is also extended to plasma mixtures. (auth)

25528 (ARL-88) TRANSFORMATION OF OBSERVED PROJECTED INTENSITIES INTO RADIAL DISTRIBUTION OF THE EMISSION OF A PLASMA. Technical Note No. 3. Kjell Bockasten (Uppsala Univ. Inst. of Physics). July 4, 1960. Contract AF61(052)-170. 17p.

A method for finding the radial distribution of the emission from the observed projected intensities is described. It is applicable to optically thin plasmas with cylindrical or spherical symmetry, such as are encountered in plasma physics and astrophysics. The observations are introduced as a sequence of n experimental readings, which are then transformed to a set of values for the emission distribution. The transformation coefficients are tabulated for n = 10, n = 20, and in part for n = 40. The method is more accurate and more direct than previous methods, and is suitable for rapid calculating by electronic computers. The sources of errors are discussed and a numerical method for smoothing the readings is suggested. (auth)

25529 (MATT-62) A TIME-RESOLVED PROBE METHOD. Francis F. Chen (Princeton Univ., N. J. Plasma Physics Lab.). Feb. 20, 1961. Contract AT(30-1)-1238. 26p.

The accuracy of electron temperature measurements by the Langmuir probe method in a plasma with large fluctuations in space potential was checked by a method which used a floating probe in addition to the usual biased probe. The results show that the oscillations do not noticeably affect temperatures found by the standard method, so that it is not usually necessary to use the two-probe time-resolved method even in the presence of fairly large oscillations. The usefulness of this method in the case of an inhomogeneous plasma is illustrated. (auth)

25530 (ML-776) INVESTIGATION OF MICROWAVE PROPERTIES OF PLASMAS. Scientific Report No. 10, August 1—October 31, 1960. M. Chodorow (Stanford Univ., Calif. Microwave Lab.). Jan. 1961. Contract AF19(604)-5226. 14p. (AFCRL-7; AD-253848)

Observations on fluctuations in a tube with tungsten buttons heated by electron bombardment are reported. Impedance of cesium plasma is discussed. The possibility of measuring two-frequency correlations in the noise spectrum is considered. Problems involved in measuring harmonics in plasma are discussed and data on air and argon up to the 5th harmonic are reported. Construction of a movable probe is described. Research on the electron beam interaction with a plasma is described. In the experiments on nonlinear effects in a plasma parametric amplifier, it was found that measured losses may be explained as due mainly to the volume collision rate of electrons with neutrals and possibly partially to boundary conditions. Fluctuations of number density in a plasma column are shown to result in phase modulation of a microwave signal propagating along the column. Preliminary results of an experimental comparison of an external probe coupled into a discharge and a normal Langmuir probe are given. A mechanism is proposed for the formation of the d-c sheath (so-called "r-f confinement") in which the sheath is replaced by a sheath capacitor and a current generator. Theoretical studies of nonlinearity in plasmas are summarized. (D.L.C.)

25531 (NP-10345) THE LOOP DIAGNOSTIC DEVICE. Lee O. Heflinger (Space Technology Labs., Inc. Physical Research Lab., Los Angeles). Aug. 21, 1959. Contract AF 04(647)-309. 31p. (TR-59-0000-00759)

The loop diagnostic device is a device which gives information about the radial distribution of current in the plasma of the superfast longitudinal pinch assembly. Presented are the general theory of loop operation, and applications of the theory to the case of infinite conductivity plasmas and to some special cases of finite conductivity plasmas. The constructional details of the loops are given together with some typical results. (auth)

25532 (SCR-418) STATUS OF SANDIA'S PLASMAJET LABORATORY. K. L. Shipley (Sandia Corp., Albuquerque, N. Mex.). July 1961. 18p.

Presented at the Fourteenth STA Conference, Albuquerque, N. Mex., October 17—19, 1960.

A brief description of the plasmajet laboratory is presented. Plans for enlarging the facility are discussed.

Some experimental studies being conducted with the plasma-jet (e.g., calorimetry, conductivity, Mach number, and temperature investigations) are discussed. (auth)

25533 (UCRL-6379) THE STRUCTURE OF THE ASTRON E-LAYER. Lewi Tonks (California. Univ., Livermore. Lawrence Radiation Lab.). June 10, 1961. Contract W-7405-eng-48. 24p.

For IAEA Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, Austria, Sept. 4-8, 1961.

The structure of the Astron E-layer is studied. This layer is a toroidal tube of relativistic electrons, which confines the reacting thermonuclear plasma. Three parameters are defined: the layer strength, the electron linear momentum, and a parameter dependent on the initial trajectory. Effects of variations of these parameters are studied. The dynamical friction between the E-layer and the trapped plasma is taken into account. Field reversal phenomena are described. (T.F.H.)

25534 (UCRL-6380) CONTAINMENT OF POSITRONS IN AN ASYMMETRIC MIRROR GEOMETRY. G. Gibson, W. C. Jordan, and E. J. Lauer (California. Univ., Livermore. Lawrence Radiation Lab.). June 8, 1961. Contract W-7405-eng-48. 24p.

For IAEA Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, Austria, Sept. 4-8, 1961.

A magnetic mirror device is described, whose mirror coils are tilted such that the planes containing these coils meet at angles of 0 to 5.6°. Positrons are injected into this asymmetric device at 2.2 Mev, and the containment of these positrons is studied both experimentally (by probe methods) and theoretically (by calculations of adiabatic invariants). (T.F.H.)

25535 (UCRL-6381) PRODUCTION AND CONTAINMENT OF HOT DEUTERIUM PLASMAS IN MULTISTAGE MAGNETIC COMPRESSION EXPERIMENTS. F. H. Coensgen, W. F. Cummins, W. E. Nexsen, Jr., and A. E. Sherman (California. Univ., Livermore. Lawrence Radiation Lab.). [May 16, 1961]. Contract W-7405-eng-48. 22p.

For IAEA Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, Austria, Sept. 4-8, 1961.

A hot D^+ plasma is produced by multi-stage magnetic compression of a cold gas containing D^+. The cold gas enters a cylinder containing a weak coaxial magnetic field, and the field is increased to a high value B in a time that is short compared to the ion-ion relaxation time but long compared to the ion cyclotron period. After this initial heating, the plasma is moved, by means of a transfer magnet, into a region having a field strength about 4B, thus causing further heating. The hot plasma is contained in this region for about 1 msec in a volume of about 2 liters, and achieves a density of around 10^{13} ions/cm^3 and a temperature of around 3.6°K. Evidence for the occurrence of the fusion reactions $D(D,n)He^3$ and $D(D,p)H^3$ in this plasma is presented. (T.F.H.)

25536 (UCRL-6383) ENERGY TRANSFER FROM HOT IONS TO COLD ELECTRONS IN A PLASMA. John Killeen, Warren Heckrotte, and Garret Boer (California. Univ., Livermore. Lawrence Radiation Lab.). June 12, 1961. Contract W-7405-eng-48. 19p.

For IAEA Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, Austria, Sept. 4-8, 1961.

The Fokker-Planck equations are used in the examination as a mathematical description of the ion and electron distribution functions in velocity space. Difference equations are developed to replace the partial differential equations for the functions: $f_+(v,t)$ and $f_-(v,t)$, where v is the magnitude of velocity, and t is the time. The numerical results of the equations are presented and compared with the results predicted by transfer rates given by Spitzer, based on a quasi-equilibrium theory assuming that the electrons have Maxwellian velocity distributions. (B.O.G.)

25537 (UCRL-6384) THE "MIRROR INSTABILITY" FOR FINITE PARTICLE GYRO-RADIUS. Harold P. Furth (California. Univ., Livermore. Lawrence Radiation Lab.). [May 9, 1961]. Contract W-7405-eng-48. 22p.

For IAEA Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, Austria, Sept. 4-8, 1961.

Mirror instabilities in plasmas are studied for the case in which the gyro-radii of the particles in the plasma are finite. The modes and wavelengths of the maximum growth rates are obtained. By allowing the gyro-radius to be finite, the case of field reversal may be examined. The theoretical results are applied to high energy injection devices, Astron, and theta pinches with reversed fields. (T.F.H.)

25538 (UCRL-6393) PLASMA PRODUCTION BY THE TRAPPING OF ENERGETIC ATOMS. C. C. Damm, A. H. Futch, F. Gordon, A. L. Hunt, E. C. Popp, R. F. Post, and J. F. Steinhaus (California. Univ., Livermore. Lawrence Radiation Lab.). June 12, 1961. Contract W-7405-eng-48. 21p.

For IAEA Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, Austria, Sept. 4-8, 1961.

A study is made of the production of plasmas by trapping energetic atoms in magnetic mirror fields. The initial trapping may be accomplished either by the residual gas or by the introduction of a cold plasma through the mirror, along the axis and inside the loss cone of the mirror. The effects of parametric variations are studied. The effects of several instabilities, such as the mirror instability, the electrostatic plasma resonance instability, and the slow Álfven instability, are discussed. (T.F.H.)

25539 (UCRL-9500) CONTROLLED THERMONUCLEAR RESEARCH QUARTERLY REPORT, SEPTEMBER, OCTOBER, NOVEMBER 1960. (California. Univ., Livermore. Lawrence Radiation Lab. and California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 15, 1960. Contract W-7405-eng-48. 119p.

Progress is reported in detail for the following programs and projects: Pyrotron (magnetic mirror) program, Astron program, Livermore Pinch program, Berkeley plasma research, and plasma physics. (D.L.C.)

25540 (UCRL-9598) CONTROLLED THERMONUCLEAR RESEARCH QUARTERLY REPORT, DECEMBER 1960 THROUGH FEBRUARY 1961. (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 15, 1961. Contract W-7405-eng-48. 98p.

Progress is reported in detail on the Pyrotron (Magnetic Mirror) program, Astron program, Livermore pinch program, Berkeley plasma research program, and plasma physics investigations. (D.L.C.)

25541 (FRL-TN-26) CONFINING A PLASMA BY A MAGNETIC FIELD. A. Koller. Translated for Picatinny Arsenal from Raketentech. u. Raumfahrtforsch., 3: No. 4, 109-15(1959). 25p. (AD-254017)

The various possibilities of containing a plasma within a

confined volume by means of electromagnetic forces are discussed systematically. An additional suggestion is brought forward according to which the plasma is kept in a non-stationary state by periodically alternating the two pinch effects. (auth)

25542 (JPRS-9579) CERTAIN PROBLEMS IN MAGNETOHYDRODYNAMICS CONSIDERING THE FINITE CONDUCTIVITY OF THE MEDIUM. I. I. Nochevkina (Nochevinka). Translated from Vestnik Moskov. Univ. Ser. III. Fiz., Astron., 16: No. 1, 49-55(1961). 13p.

An approximating technique is advanced for the solution of the equations which describe the planar, isentropic flow of an ultrarelativistic gas in an arbitrary magnetic field. Planar motion of an ideally compressible fluid with finite conductivity in a transverse magnetic field was investigated. (M.C.G.)

25543 (TG-230-T160) QUANTUM KINETIC EQUATION FOR A MULTICOMPONENT PLASMA. S. V. Temko. Translated by R. P. Illwitzer for Johns Hopkins Univ. from Nauch. Doklady Vysshei Shkoly, Fiz.-Mat. Nauki, No. 2, 189-91(1958). 5p.

A quantum kinetic equation is found for an M-component plasma ($M \geq 2$). Equations are found for the particle-particle interactions, taking account only of pair correlations, and for interactions between various types of particles, with quantum correlations. These equations are combined, under the assumptions of high temperature, high density, and weak interactions, in order to obtain the quantum kinetic equation. (T.F.H.)

25544 (TG-230-T226) BUILD-UP OF ELECTROMAGNETIC WAVES IN A STREAM MOVING THROUGH A PLASMA IN THE PRESENCE OF A MAGNETIC FIELD. V. O. Rapoport. Translated by R. P. Illwitzer for (Johns Hopkins Univ.) from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 3: 737-45(Sept.-Oct. 1960). 12p.

The buildup of electromagnetic waves is considered in a stationary plasma through which a plasma stream flows. The stream flows along the lines of force of the constant magnetic field in which the plasmas are situated. It is found that the stream must be rarefied with respect to the stationary plasma, in order for electromagnetic wave buildup (or attenuation) to occur. The buildup coefficients, and the frequencies for which buildup occurs, are found as functions of the angle of emission with respect to the direction of the magnetic field. (T.F.H.)

25545 FILAMENTARY STRUCTURE PRODUCED BY AN ELECTRIC CURRENT IN A PLASMA. H. Alfvén (Royal Inst. of Tech., Stockholm). Arkiv Fysik, 19: 375-8(1961). (In English)

It is shown that in a plasma at low pressure an electric field parallel to a magnetic field produces a current which is confined to a filament. Simple formulas are given for the cross section of the filament and the current in it. (auth)

25546 PLASMA ENGINEERING. PART II. MEASURING PARAMETERS. Michael F. Wolff. Electronics, 34: No. 31, 33-9(Aug. 4, 1961).

Diagnostic techniques and equipment for measuring the parameters of plasma are discussed and reviewed. The techniques fall into two groups: techniques that introduce perturbations into the plasma and techniques that do not. The former involve the use of probes such as electric and magnetic probes; the latter include observing the radiation emitted from the plasma by photography and spectroscopy. The parameters such as particle temperature, density, and velocity may be measured by one or more of the techniques described. (N.W.R.)

25547 RADIATION BY CHARGED PARTICLES PASSING THROUGH AN ELECTRON PLASMA IN AN EXTERNAL MAGNETIC FIELD. S. K. Majumdar (Saha Inst. of Nuclear Physics, Calcutta). Proc. Phys. Soc. (London), 77: 1109-20 (June 1, 1961).

The motion of a charged particle through a low density electron plasma in an external magnetic field is investigated. The interaction of the particle through transverse waves only is considered, and the consequent energy losses are calculated. It is found that the coupling between the longitudinal plasma wave and the transverse electromagnetic wave modifies the nature of radiation emitted by the particle. For a velocity greater than that needed to excite plasma waves in the medium, the particle emits non-Čerenkov radiation, as well as Čerenkov radiation. (auth)

25548 THE COLLECTIVE TREATMENT OF A FERMI GAS. [PART] II. T. Gaskell (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 77: 1182-92(June 1, 1961).

The ground state energy of the free electron gas is calculated using the Rayleigh–Schrödinger variational method with the wave function $\Psi = D\Pi_{i<j} f(x_{ij})$ where D is a determinant of plane waves and $f(x_{ij})$ a correlation function. Consideration of the wave function, in terms of the collective coordinates that represent the Fourier components of the density, suggests an accurate approximation for the energy integral. This integral is evaluated over the coordinates of the particles so that the use of subsidiary conditions is avoided. Effects omitted in the random phase approximation are included and the final results extend continuously over plasma and particle modes and should be valid in the range of densities encountered in real metals. (auth)

25549 NON-LINEAR THEORY OF PLASMA OSCILLATIONS. A. I. Akhiezer, G. Ya. Lyubarskii, and Ya. B. Fainberg. Trudy Fiz. Otdel. Fiz.-Mat. Fak. Khar'kov. Gosudarst. Univ. im. A. M. Gor'kogo, 6: 73-80(1955). (In Russian)

The process of plasma oscillation is analyzed using simple non-linear problems; including longitudinal oscillations of unrestricted plasma at absolute zero; the excitation of oscillations by a charged plane in motion at constant rate; and non-linear oscillations at finite temperature excited by charged particles. (R.V.J.)

25550 CERTAIN RESULTS OF INVESTIGATIONS ON CONTROLLED THERMONUCLEAR REACTIONS IN THE SOVIET UNION. I. V. Kurchatov. Uspekhi Fiz. Nauk, 73: 605-10(Apr. 1961). (In Russian)

The early work with OGRA, including operational details, is reviewed. Magnetic fields up to 8000 gauss in the mirror and 5000 gauss in the central region can be obtained with the machine. The over-all length between the central planes of the mirror may reach 12 m. Mercury diffusion pumps, ion-absorption pumps, and evaporated Ti layers were used for pumping the neutral gas. After baking the central volume, the minimum gas pressure was of the order of $2 \cdot 10^{-8}$ mm of Hg. The length of the path of the injected molecular ions before returning to the magnetically shielded injection canal was measured by two methods and was found to be 800 and 1200 m; the maximum observed lifetime of the trapped protons was 3.5 millisec. The variation of $1/\tau$ with the pressure was determined, discussing the significance of the non-zero intercept of $1/\tau$ versus the pressure curve in the light of Ioffe's work, including its amplification as evidence of an instability. (TTT)

25551 STUDIES ON THE EXPERIMENTAL THERMONUCLEAR APPARATUS OGRA. I. N. Golovin, L. I. Artemenkov, G. F. Bogdanov, D. A. Panov, V. I. Pistunovich, and N. N.

Semashko (Inst. of Atomic Energy, Academy of Sciences, USSR). Uspekhi Fiz. Nauk, 73: 685-700(Apr. 1961). (In Russian)

The theoretical and experimental studies with the OGRA machine are reviewed up to the spring of 1960, describing the theoretical conditions of the critical current for the attainment of a high-motion plasma density. Included are the investigations on the cross sections for charge exchange of protons and dissociation of molecular ions. The importance of high pumping speed and the significance of increasing the energy of the injected molecular ions is particularly stressed. The experimental work reviewed involves injected molecular ion currents up to 35 milliamp at an energy less than 200 kev, and pumping speeds yielding $2 \cdot 10^{-8}$ mm of Hg pressure rise per injected milliamp. A typical experimental result showed 200 milliamp current at 200 kev, a trapped proton lifetime of 3 millisec and a trapped density of 10^7 cm^{-3}. The diagnostic techniques available for use with OGRA includes measurement of the resonance frequency shift of the OGRA chamber with plasma density and a microwave interferometer for determining electron densities above 10^6 cm^{-3} level as function of time. Antennas placed outside the mirrors have been used to observe proton molecular ion cyclotron frequencies and to monitor the onset of harmonics as a function of plasma density. The onset of instabilities and their cure are also discussed. (TTT)

25552 PLASMA STABILITY. A. A. Vedenov, E. P. Velikhov, and R. Z. Sagdeev. Uspekhi Fiz. Nauk, 73: 701-66(Apr. 1961). (In Russian)

A general review of the theories on the stability of plasma is presented, stressing in particular the physical concepts behind the various approaches. Both the aperiodic macroscopic instabilities and the microscopic oscillatory effects of plasmas are considered. The former are applied to gross instabilities observed in such sources as high current discharges and rotating plasmas while the oscillatory instabilities include effects of interpenetrating beams and beam-plasma interactions. Non-isotopic velocity distributions are also considered. (50 references). (TTT)

25553 HYDRODYNAMIC SHOCK WAVES IN THE LINEAR PINCH. W. Köppendörfer (Technische Hochschule, Munich). Z. Naturforsch., 16a: 484-91(May 1961). (In German)

Hydromagnetic shock waves were achieved on a linear pinch collapse. To approach the hydromagnetic two-fluid model, a strong pre-ionization was used. If the conductivity of the plasma is high and the gas fully ionized, the mass density must be proportional to the stabilizing field within the current sheet. By this way the structure of shock waves could be obtained from magnetic field measurements. (auth)

25554 METHOD OF INITIATING AND SUSTAINING AN ENERGETIC PLASMA FOR NEUTRON PRODUCTION. P. R. Bell, R. J. Mackin, Jr., and A. Simon (to U. S. Atomic Energy Commission). U. S. Patent 2,997,431. Aug. 22, 1961.

A method for producing an energetic plasma for neutron production and for fueling this plasma once it is formed is described. The plasma is initially formed as set forth in U. S. Patent No. 2,969,308. After the plasma is formed, cold neutral particles with an energy of at least 1 Kev are injected in a radial direction and transverse to the axis of the device. These cold particles are substituted for the molecular ion injection and are used for fueling the plasma device on a continuous regulated basis in order to maintain a reaction temperature of about 60 Kev for producing neutrons. (AEC)

25555 GAS IONIZING AND COMPRESSING DEVICE. Edward M. Little, David B. Thomson, Vernal Josephson, and Franklin Robert Scott (to U. S. Atomic Energy Commission). U. S. Patent 2,997,436. Aug. 22, 1961.

A device is described for producing high energy gaseous plasmas. The device consists of a unitary refractory vessel having tapered end portions, a cylindrical middle portion, and means for spontaneously generating oppositely propelled plasma masses from the tapered end portions to a collision zone in the cylindrical middle portion. The means come from the spontaneous generation of diverging magnetic fields in the end portions and an axial magnetic field in the cylindrical portion. (AEC)

25556 PLASMA DEVICE. William R. Baker (to U. S. Atomic Energy Commission). U. S. Patent 2,997,641. Aug. 22, 1961.

A device is described for establishing and maintaining a high-energy, rotational plasma for use as a fast discharge capacitor. A disc-shaped, current-conducting plasma is formed in an axial magnetic field and a crossed electric field, thereby creating rotational kinetic energy in the plasma. Such energy stored in the rotation of the plasma disc is substantial and is convertible to electrical energy by generator action in an output line electrically coupled to the plasma volume. Means are then provided for discharging the electrical energy into an external circuit coupled to the output line to produce a very large pulse having an extremely rapid rise time in the waveform thereof. (AEC)

Shielding

25557 (AD-254092) INTERIM REPORT ON ATTENUATION OF POINT SOURCE GAMMA RADIATION IN SLABS. E. T. Clarke, H. A. Mehlhorn, and R. Gold (Technical Operations, Inc., Burlington, Mass.). Mar. 31, 1961. Contract DA-49-146-XZ-035). 41p. (TO-B 61-15)

Protection afforded by structures against γ rays due to a nuclear explosion in the atmosphere is investigated. Calculations are made for the differential dose-rate spectra due to fission products and due to thermal neutron capture in N_2 as functions of distance from explosion and time, extending for several minutes after explosion. The accumulated air dose due to N_2 capture is found to be far more important than that from fission products for several minutes at most distances. The importance increases with distance and decreases with time. Some effects of nuclear weapon design on these conclusions are discussed. An experimental program for measuring γ ray attenuation in steel slabs is described and some preliminary data reported. (D.L.C.)

25558 (ANL-6242) A GEOMETRY CORRECTION FOR PLANE SOURCE AGE MEASUREMENTS IN HYDROGENOUS MEDIA. Edgar F. Bennett and Jack Haugsnes (Argonne National Lab., Ill.). Apr. 1961. Contract W-31-109-eng-38. 21p.

A method is presented for calculating the age from an indium resonance neutron flux distribution measured along the normal to a large ($\geq$10 root ages) plane fission plate immersed in an hydrogenous medium of infinite extent. The calculation is a modification of one suggested by M. E. Rose and A. M. Weinberg for use in age measurements in media which can be characterized by energy independent extrapolation lengths. The modification consists of introducing small correction terms which are integrals over the point displacement kernel at distances greater than the neutron source half-width. The approximate form of the kernel in this region must be inferred from the data. A numerical example of the use of the method is given. The integrals required in the calculation have been evaluated

and tabulated for a range of foil exposure geometries. (auth)

25559 (BRL-1130) THE TRANSMISSION OF MONOENERGETIC NEUTRONS THROUGH POLYETHYLENE. MACHINE CALCULATIONS. Frank J. Allen, Arnold Futterer, William Wright, and Alfred Budka (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Apr. 1961. 211p.

Detailed results of calculations of the transport of monoenergetic neutrons through plane, laterally infinite, slabs of polyethylene containing 8 wt % boron carbide are given. The results consist of machine printouts and are in tabular form. Less extensive results are given for pure polyethylene. The calculations were made by the Monte Carlo method. (auth)

25560 (CF-61-6-58) SHIELDING OF THE HFIR PRIMARY COOLANT DEAERATOR AND CONDENSERS. H. A. McLain (Oak Ridge National Lab., Tenn.). June 16, 1961. 18p.

The shielding recommended for the HFIR primary coolant deaerator, steam jets, and condensers is 6 in. of lead plus 2 ft of ordinary concrete. This shielding is required because the reactor is being designed for a possible meltdown of the fuel element within the pressure vessel. The fission product gases released during such a meltdown tend to concentrate in the deaerator and the condensers. Shielding recommended for the meltdown situation is more than adequate for protection during the normal operating conditions of the reactor. (auth)

25561 (IDO-16653) ETR GAMMA HEAT GENERATION MEASUREMENTS FOR CYCLES 27, 33, AND 34. L. D. Weber and C. H. Hogg (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). May 31, 1961. Contract AT(10-1)-205. 34p.

The gamma heat generations in selected positions of the ETR were measured for Cycles 27, 33, and 34. The measurements for Cycle 27 include data for the clean core and depleted core. Maximum gamma heat generation maps are presented for each cycle along with vertical traverses for all positions monitored. The measurements were made using a graphite-CO_2 ionization chamber. (auth)

25562 (NAA-SR-6244) GAMMA-RAY HEAT GENERATION IN THE HNPF BIOLOGICAL SHIELDS. S. Berger (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 30, 1961. Contract AT 11-1-GEN-8. 23p.

The methods of analysis and required data used in evaluating the gamma-ray heat generation in the axial and radial concrete biological shields of the Hallam Nuclear Power Facility are presented. Results of the calculations are also presented. The method used in calculating the various contributions to the total heat generation is discussed in some detail. As a prerequisite to calculating the capture gamma-ray contribution, the fast and thermal neutron flux distributions were determined. The specific activity of the Na coolant was also calculated. The maximum values of the heat generation were found to be about 0.65×10^{-4} and 1.8×10^{-4} watts/gm in the axial and radial concrete biological shields, respectively. These values correspond to heat fluxes of 7.8 and 22 Btu/hr-ft^2 in the top and side concrete shields, respectively. In the top shield, this is due primarily to the absorption of the decay gamma-rays from Na^{24} in the coolant. In the radial shield, the capture gamma-rays generated there are the predominant source of heat. (auth)

25563 (NASA-TN-D-873) RADIAL FLUX OR FIELD OF AN ISOTROPIC, CYLINDRICAL SOURCE OF FINITE EXTENT. Edmund E. Callaghan and Lawrence Flax (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). July 1961. 27p.

The radial particle flux or radial electric field intensity at any point outside a cylindrical, isotropic source of finite extent is derived in terms of tabulated elliptic functions. Dimensionless plots are presented for a wide range of source lengths. (auth)

25564 (NP-9851(Vol.I)) NUCLEAR WEAPONS RADIATION DOSES IN ARMORED VEHICLES. J. S. Rosen, M. O. Burrell, D. L. Cribbs, C. W. Hill, W. B. Ritchie, and J. C. Whiton (Lockheed Nuclear Products, Marietta, Ga.). July 1960. 145p. (NR-82(Vol.I))

An analytic study is presented for predicting the doses within the interior of armored vehicles due to the initial neutron and gamma radiation from any specific nuclear weapon. Basic data are generated by Monte Carlo techniques for the penetration of neutrons and gamma rays through iron slabs, neutron capture, neutron inelastic scattering, and neutron albedos. A computer program for calculating crew doses contains independent sections which can accommodate new vehicle geometry or weapons radiation environments. (auth)

25565 (NP-9851(Vol.III)) A MONTE CARLO CALCULATION OF NEUTRON PENETRATIONS THROUGH IRON SLABS. Nuclear Report 82. M. O. Burrell and D. L. Cribbs (Lockheed Nuclear Products, Marietta, Ga.). May 1960. 130p. (NR-82(Vol.III))

A stochastic technique is used to calculate the transmitted and reflected number current, flux, and dose rates of monoenergetic, monodirectional beams of neutrons impinging upon iron slabs. Results are presented for five thicknesses of iron, five source energies, and five incident angles. Scattered dose transmission factors and dose reflection factors are determined for 120 equal solid angles. A weighted average energy of the transmitted and reflected neutrons is determined for each solid angle. (auth)

25566 (ORNL-3130) BARYTES CONCRETE FOR RADIATION SHIELDING: MIX CRITERIA AND ATTENUATION CHARACTERISTICS. William J. Grantham, Jr. (Oak Ridge National Lab., Tenn.). July 25, 1961. Contract W-7405-eng-26. 58p.

Concrete mix design criteria, based on existing theories of proportioning and specifically oriented toward the solution of radiation shielding problems, were developed. Effects of aggregate gradation, cement-to-aggregate ratio, and water content were examined. A barytes concrete, designed according to these criteria, was thoroughly investigated in the Lid Tank Shielding Facility. Relative effectivenesses of dry aggregates, aggregates plus cement, and cured concrete were compared through thermal-neutron flux, fast-neutron dose, and gamma-ray dose measurements behind slab configurations. Attenuation was measured for the aggregate, the aggregate plus cement, and for the barytes concrete. Comparison with attenuations calculated on the basis of removal cross sections for the measured chemical compositions showed satisfactory agreement. (auth)

25567 A MATERIAL WHICH IS PROTECTIVE AGAINST IONISING RADIATIONS. Jaroslav Slaba and Vladimir Potucek. British Patent 873,528. July 26, 1961.

Bricks, sheet, or plaster which have more shielding power against ionizing radiations than barite plasters may be prepared by mixing waste materials from lead refining

processes with a binding agent, e.g., cement. These waste materials may be either sifted lead sweepings, lead oxide dust, or arsenic dust. Characteristics of plasters prepared in this way are tabulated. Considerable savings in barite, cement, and plaster are obtained because thinner layers may be used than in the case of barite plasters. (D.L.C.)

Theoretical Physics

25568 (AFOSR-772) TWO-POINT FUNCTION AND GENERALIZED FREE FIELDS. Physics Department Technical Report No. 210. A. L. Licht and J. S. Toll (Maryland. Univ., College Park). Apr. 8, 1961. Contract AF 49 (638)-24. 12p.

Several theorems are proven which relate to the possibility of constructing a noninteracting field with an arbitrary two-point Wightman function. They are: if φ (x) is a complete local field, and $[\varphi(x), \varphi(y)] = D(x-y)$, where D is an arbitrary operator depending on x and y only through their difference, then D is a c-number function; such fields are generalized free fields, as defined by Greenberg; and any generalized free field is unitarily equivalent to a superposition of Klein-Gordon fields, and moreover the asymptotic condition and unitarity restrict this to a superposition of ordinary free fields with different discrete masses. (auth)

25569 (JINR-D-561) AXIOMATIC METHOD AND PERTURBATION THEORY. B. V. Medvedev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 8p.

It is shown that once the perturbation theory is adopted, the formal expansion of the scattering matrix in powers of the coupling constant follows from the basic principles of the axiomatic approach supplemented by assumptions on the transformation properties of the fields considered and about the degrees of growth of the matrix elements with the same ambiguity as in the usual theory. The study was restricted to the case of one scalar field/out-field. (M.C.G.)

25570 (NYO-9748) THE QUANTUM MECHANICAL SCATTERING PROBLEM. Thomas F. Jordan (Rochester, N. Y. Univ.). June 27, 1961. Contract AT(30-1)-875. 26p.

A mathematically rigorous formulation of the quantum mechanical scattering problem is given which reflects the stationary state point of view but is not limited by any dependence on configuration space methods. It is shown that, under the conditions necessary for the time-dependent formulation, the wave operators defined by the asymptotic limits provide a unique solution. The possibility that a solution can exist when the asymptotic conditions are not valid is investigated by defining wave operators by an integral representation. The conditions sufficient for these wave operators to be a solution of the scattering problem are shown to be weaker than the conditions necessary for the time-dependent formulation. Hence, there will in general be a class of Hamiltonians for which a solution of the scattering problem exists but for which the asymptotic conditions are not valid. However, no sufficient conditions are given to explicitly characterize such a set of Hamiltonian operators. This unsolved mathematical problem is outlined. (auth)

25571 FROM DUALISM TO UNITY IN QUANTUM PHYSICS. Alfred Lande. Cambridge, England, University Press, 1960. 130p.

The wave-particle dualism found in quantum mechanics is reviewed. The concepts of probability, causality, observability, etc., are examined. It is proposed, on physical grounds, that elementary particles are actually particles, and that wave effects arise only from statistical considerations. (T.F.H.)

REACTOR TECHNOLOGY

General and Miscellaneous

25572 (AGN-TM-381) HECTIC, AN IBM 704 COMPUTER PROGRAM FOR HEAT TRANSFER ANALYSIS OF GAS-COOLED REACTORS. W. C. Reynolds, D. W. Thompson, and C. R. Fisher (Aerojet-General Nucleonics, San Ramon, Calif.). May 1961. Contract AT(10-1)-880. 58p.

HECTIC is an IBM 704 computer program for calculating heat transfer rates and temperatures in the fuel elements of typical gas cooled nuclear reactors. The program is flexible and unique in that the effects of turbulent interchange between flow passages are considered. The computation procedure amounts to a "nodal" or "lumped parameter" type calculation. (auth)

25573 (ANL-6083) METALLURGICAL EVALUATION OF FAILED BORAX-IV REACTOR FUEL ELEMENTS. Final Report—Metallurgy Program 7.6.11. C. F. Reinke, L. A. Neimark, R. Carlander, and J. H. Kittel (Argonne National Lab., Ill.). May 1961. Contract W-31-109-eng-38. 36p.

The fuel elements for the Borax-IV boiling water reactor consisted of ThO_2—6.36 wt % UO_2 pellets lead-bonded in X8001 aluminum alloy tube plates with silicon-bonded end closures. When the reactor was brought to power on February 19, 1958, after having been operated for approximately one year, over one-third of the fuel elements were found to have developed leaks, as evidenced by significant fission gas release into the process water. Since no fission breaks had been detected during the last previous operation of the reactor on December 5, 1957, it appeared that the leaks had developed during the 2½-month shutdown. A detailed metallurgical examination was made of two elements containing several failed tubes to determine the causes of failure and the amount of fission gas released from oxide pellets in unfailed tubes. It was found that the upper portion of each tube, where a void space had been intentionally left above the pellets, had collapsed under the reactor operating pressure. The reverse bending which occurred in the tube walls caused local cracking. The most probable cause for the leaks which developed during shutdown is considered to be corrosion in cracks and crevices of the collapsed tubing. The performance of the silicon-bonded end closures appeared to be quite adequate. Measurements and analyses of gas samples taken from unfailed tubes showed that the pellets released an average of 3.4 percent of the total fission gas yield, although they had operated at relatively low temperatures. The release is attributed to open porosity which existed in the pellets. (auth)

25574 (ANL-6365) FLUX AND TEMPERATURE PEAKING EFFECTS RESULTING FROM THE USE OF SEAMED FUEL TUBES IN CP-5. D. P. Moon (Argonne National Lab., Ill.). May 1961. Contract W-31-109-eng-38. 18p.

The flux peaking factor resulting from the use of a seamed fuel thimble in CP-5 was determined experimentally and by diffusion theory calculations. A comparison of the two methods indicates that an underestimation of the magnitude and sharpness of the flux peak is obtained from the diffusion calculations. Based on this comparison, a conservative calculation of the peaking effect which would result from the use of seamed fuel tubes in CP-5 indicates a maximum local power-peaking factor of 1.10 and a maximum fuel surface temperature 3°C above that obtained with extruded tubes for the same total reactor power and the same flow conditions. (auth)

25575 (BAW-1220) SPECTRAL SHIFT CONTROL REACTOR BASIC PHYSICS PROGRAM, QUARTERLY TECHNICAL REPORT NUMBER 3, JANUARY—MARCH 1961. (Babcock and Wilcox Co., Atomic Energy Div., Lynchburg, Va.). Contract AT(30-1)-2602. 82p.

A summary of the work accomplished during the third contract quarter (January 1 to March 31, 1961) on the Spectral Shift Control Reactor (SSCR) Basic Physics Program is presented. The major objective of the program is to determine basic physics parameters of tight-packed lattices of slightly enriched fuel in moderators consisting of D_2O-H_2O mixtures. The concentration of the D_2O-H_2O mixtures are varied so as to apply to the spectral shift concept. The required license amendment was issued, and the first critical experiment containing heavy water in the moderator (76.7 mole % D_2O) was performed with 4%-enriched UO_2 fuel rods. Reported are measurements of the critical mass, critical buckling, thermal disadvantage factor, cadmium ratio of U^{235} and U^{238}, epithermal neutron spectrum, and the effect of moderator channels. The operating license for the room temperature exponential experiments was issued, and preliminary buckling measurements with $(U^{235} + Th)O_2$ fuel in a moderator containing 80 mole % D_2O were made. The results of hot exponential experiments at 70 to 400°F with 4%-enriched UO_2 fuel in light water moderator are also reported. Neutron age measurements in a lattice of ThO_2 rods in light water and 90 mole % D_2O, parallel and perpendicular to the rod axis, were completed and a preliminary analysis of the results is presented. Theoretical studies continued. The BPG computer code, which will be used to analyze experiments with D_2O in the moderator, was refined by improving the methods of computing resonance absorption and the transport cross sections for fast neutrons. Alternate methods of computing Dancoff shielding in the lattice and resonance absorption in fertile material were considered, and BPG and P1MG calculations were compared to assess the importance of the choice of neutron spectrum in the reflector. Additional calculations in support of the experimental work also continued. (auth)

25576 (BMI-1531) THERMODYNAMICS OF BORON LOSS IN UO_2-STAINLESS STEEL DISPERSION FUEL ELEMENTS. James J. Ward, Carl A. Alexander, Alexis W. Lemmon, Jr., and Robert B. Filbert, Jr. (Battelle Memorial Inst., Columbus, Ohio). July 18, 1961. Contract W-7405-eng-92. 23p.

Thermodynamic studies were made to determine the mechanism involved in loss of boron in the SM-2 fuel element. The reference fuel element contains a core of approximately 26 wt % UO_2 and 1 wt % ZrB_2 dispersed in Type 347 stainless steel matrix 0.030 in. thick and clad with 0.005-in.-thick stainless steel. By means of calculating the standard free-energy reaction, 108 of 500 postulated reactions were evaluated quantitatively. The standard free energies of formation of the compounds of interest were compiled from the literature or were either calculated or estimated. In the case of ZrB_2, the standard free-energy value was confirmed by experiments. ZrB_2 has been found to react appreciably with nitrogen, oxygen, water, and UO_2, but it appears unlikely that the boron re-

action product can volatilize appreciably and be lost from the surface because a large driving force exists for condensation of the gaseous boron product. Loss of boron vapor by dissociation or disproportionation appears unlikely on the basis of thermodynamic calculations. Diffusion of boron through the solid and reaction with oxygen to give molten B_2O_3 at the surface is possible. Sufficient thermodynamic driving force is available to give appreciable redistribution, segregation, and loss of boron from the solid body of the fuel element by diffusion of boron in the solid. (auth)

25577 (BNL-661) TABLE OF REACTOR COOLANT PROPERTIES. Leon Green (Brookhaven National Lab., Upton, N. Y.). Mar. 10, 1961. 13p.

Selected properties of coolants currently being considered for use in nuclear reactors are presented. Physical, chemical, and nuclear properties that must be considered in selecting reactor coolants are listed. Data on cost, material compatibility, toxicity, and non-nuclear hazards are also given. A number of combined parameters were evaluated that are helpful in comparing such important criteria as low pumping power, wide temperature range, low induced activity, and moderating properties. Included is a bibliography listing references to additional data. (auth)

25578 (CF-61-6-83) ECONOMICS OF THORIUM FUEL CYCLES. P. R. Kasten, L. G. Alexander, R. Carlsmith, and R. Van Winkle (Oak Ridge National Lab., Tenn.). June 22, 1961. 36p.

Thorium utilization appears to permit development of an advanced technology involving fuel handling, processing, and refabricating on an economic basis. Based on U. S. cost rules, countercurrent fueling, and a throw-away cycle, heavy-water reactors fueled with Th-U^{235} had fuel costs as low as natural-uranium-fueled systems. The spent fuel from the thorium system contained four times as much fissionable fuel as that from the natural-uranium system, and so processing costs and/or refabrication costs for the thorium fuel could be relatively high and still be economical. With fuel processing, U. S. processing charges, and uniform-batch fueling, light-water reactors fueled with Th–U^{235} had lower fuel costs than slightly-enriched-uranium reactors; for higher neutron-economy systems, the uranium reactors had lower fuel costs in the initial uniform-batch cycle, but recycle of thorium fuel was generally more economic than recycle of uranium fuel. Based on the existence of an economic, advanced technology, calculated fuel-cycle costs for thorium-breeder reactors (including special-materials inventory charges) were less than 1 mill/kwh. The aqueous-homogeneous breeder reactor studied had a fuel cost of about 0.9 mill/kwh at a fuel yield of 7% per year, while a molten-salt-breeder reactor had a fuel cost of about 0.6 mill/kwh at a fuel yield of 1% per year. (auth)

25579 (CF-61-6-93) EFFECT OF ADDITION OF INOR-8 LINING INSIDE BAYONET FUEL TUBES ON PERFORMANCE OF THE MSBR. L. G. Alexander (Oak Ridge National Lab., Tenn.). June 20, 1961. 3p.

If INOR-8 liners having a thickness of 20 mils are used in the Molten Salt Breeder Reactor, the maximum breeding ratio will be about 1.00. The associated fuel cycle cost in this reactor will be about 1.8 mills/kwhr; this cost is about 0.13 mills/kwhr above that corresponding to the elimination of the INOR-8 tubing. (auth)

25580 (CNI-38) METODO A DUE GRUPPI PER LA DETERMINAZIONE DI CONDIZIONI CRITICHE E FLUSSI IN REATTORI RIFLESSI CILINDRICI O PARALLELEPIPEDI. (Two Group Method for Determining Critical Conditions and Fluxes in Reflected Cylindrical and Parallelepiped Reactors). S. Albertoni and C. Tamagnini (Italy. Comitato Nazional per le Ricerche Nucleari. Centro di Studi Nucleari, Ispra). Mar. 1960. 135p.

Sheets for two-group criticality calculation and flux tabulation are set up following the Spinrad's scheme. Cylindrical and parallelepiped reactors are considered. The sheets take into account the possibility of anisotropy in the neutron diffusion, asymmetry in the axial reflectors, eigenvalue ≤ 0, and annular multiplying region. Adjoint fluxes are considered also. (auth)

25581 (CRDC-1027) A PRELIMINARY REPORT ON RADIAL DISTRIBUTION OF FISSION-PRODUCT XENON AND CESIUM IN UO_2 FUEL ELEMENTS. W. W. Morgan, R. G. Hart, R. W. Jones, and W. J. Edwards (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1961. 17p. (AECL-1249)

It is evident that both xenon and cesium are grossly depleted in the regions of the fuel where pronounced grain growth has occurred and that little depletion occurs in the region where grain growth is not apparent. It is suggested that a mechanism other than diffusion releases both xenon and cesium from the region of pronounced grain growth but this mechanism has not been established. Plutonium distributions and some xenon and cesium isotope ratios are reported. The analytical method used for the xenon analyses is described. (auth)

25582 (CRRL-1019) THERMAL CHARACTERISTICS OF THE TEST SECTION OF A PRESSURIZED WATER LOOP. D. T. Nishimura (Atomic Energy of Canada Ltd., Chalk River, Ont.). Feb. 1961. 36p. (AECL-1248)

At Chalk River UO_2 fuels are under study in simulated power reactor conditions. A set of data which assist in interpreting the effects observed during post-irradiation examination are the calorimetric power outputs of the fuel. To obtain good calorimetric power output values corrections for heat loss and gamma heating were determined experimentally. This correction for the X-2 type loop in the NRX reactor was about +3 kW at 260°C at 40MW reactor power. The power output measurement accuracy for a fuel string was about ±3%. (auth)

25583 (DEG-Report-319) THE DISTRIBUTION OF FLUX AND TEMPERATURE IN THERMAL REACTOR FUEL RODS. I. S. McGill (United Kingdom Atomic Energy Authority. Industrial Group. Dounreay Experimental Reactor Establishment, Caithness, Scotland). Jan. 25, 1961. 28p.

It is shown that Kushneriuk's approximation for the mean-to-surface flux ratio in cylindrical fuel rods gives results in good agreement with experimentally measured ratios for $(a\Sigma_t)$ values in the range $0 \leq (a\Sigma_t) \leq 2$ and is preferable to the empirical correlations at present in use in that it makes allowance for the dependence of this flux ratio on the scattering cross section of the fuel rod as well as the dependence on the absorption cross section and geometry of the fuel rod. The empirical correlations can be used to predict the flux distribution within the rod; the results, in good agreement with experiment, of the mean-to-surface flux ratio (Kushneriuk's prediction) are used to determine the basic parameter of the flux correlations. (auth)

25584 (GEAP-3256) SUMMARY OF WORK PERFORMED ON A DISCONTINUOUS POSITION SERVO SYSTEM FOR THE LOCKING PISTON DRIVE. N. J. Biglieri, G. B. Lloyd, R. J. Romeo, and W. A. Zschaler (General

Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Sept. 30, 1959. Contract AT(04-3)-189. 106p.

A discontinuous or step-positioning servo control system was designed and tested for a locking piston control rod drive for shipboard application. (D.L.C.)

25585 (GEAP-3616) REACTIVITY VS. NUMBER OF NEUTRONS CAPTURED IN CONTROL MATERIALS. Walter L. Morgan and John L. Russell, Jr. (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Dec. 30, 1960. Contract AT(04-3)-189. 22p.

An experiment was performed to determine the relation between the fraction of neutrons absorbed in a reactor by control materials and the reactivity worth of the materials in the reactor. The control material used was gold in the form of 3-in. by 6-in. by 0.025-in. slabs. The slabs were used to build thicknesses up to 0.250 inches. Measurements were made of the activation and reactivity effect of each sample. The results are compared with few-group diffusion theory. It is found that the experiment can be interpreted as a measure of the group width of the epithermal group. The data require a very narrow epithermal group and are, therefore, inconsistent with the predictions of conventional three-group diffusion theory models. (auth)

25586 (HW-57252(Suppl.I)) NPR WATER QUALITY DESIGN BASES, SUPPLEMENT I. MODERATOR COOLING SYSTEM. W. D. Bainard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 24, 1960. 4p.

Water quality criteria are presented for the moderator cooling system of the NPR. (D.L.C.)

25587 (HW-57252(Rev.3)) NPR WATER QUALITY DESIGN BASES, REVISION 3. (Mixed Primary System). W. D. Bainard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 4, 1960. 10p.

Water quality criteria are presented for the primary coolant, secondary coolant, and circulating water of the NPR. (D.L.C.)

25588 (HW-65191) THERMAL HYDRAULIC BASES FOR SELECTED PRTR PROCESS SPECIFICATIONS. J. M. Batch and T. W. Ambrose (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1, 1960. Contract AT-(45-1)-1350. 5p.

Criteria are presented for heat transfer, fluid flow, and other process variables involved in the operation of the Plutonium Recycle Test Reactor. (D.L.C.)

25589 (HW-67094) LATTICE PARAMETER MEASUREMENTS FOR A CONCENTRIC TUBE FUEL ELEMENT. D. E. Wood, K. R. Birney, and E. Z. Block (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1, 1960. Contract AT(45-1)-1350. 64p.

Lattice parameters for a concentric tube fuel element were measured in the Physical Constants Test Reactor (PCTR). The measurements reported include k_∞, f, p, and ϵ for a $10\frac{1}{2}$-inch graphite lattice with both water and air in the coolant channels, and k_∞ and f for an $8\frac{3}{8}$-inch lattice, water cooled only. The value of η derived from the $10\frac{1}{2}$-inch lattice measurements is 1.30. Measured fluxes are compared to P_3 calculations using an adjusted neutron temperature. Some of the correction factors and sources of error in the measurements are discussed. (auth)

25590 (HW-69084) XENON INSTABILITY IN GRAPHITE REACTORS. G. C. Fullmer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1961. Contract AT(45-1)-1350. 16p.

The phenomena of localized xenon oscillations and graphite temperature cycling can be adequately controlled, from the standpoint of reactor operating efficiency, by adequate provision and use of localized flux monitoring and control system flexibility. Although this control solution appears empirical in nature and thus overly simple, it has sound physical bases for yielding optimum results. These phenomena should not be regarded as having nuclear safety connotations. Their time constants are long relative to instrument and human reaction times. Rather, the possibility of their having a bearing on nuclear safety would imply that the reactor under study was not adequately instrumented and operated to monitor and control these flux distortions which frequently arise due to other operating factors. (auth)

25591 (IDO-16677) QUARTERLY TECHNICAL REPORT, SPERT PROJECT, JULY, AUGUST, SEPTEMBER, 1960. F. Schroeder, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Contract AT(10-1)-205. 23p.

Spert I. Preliminary tests were carried out on water-filled capsules containing dummy fuel rods in the reactor; no void growth was detected in the capsule for reactor periods of 10 to 900 msec. The results of the first series of tests with fuel-bearing plates in the capsule are reported. Examination of the results of the large-amplitude, low-power oscillator test of June 1960 indicate that the describing-function phase results agree well with theory; however, a frequency-dependent deviation from theory is noted. Spert II. Critical experiments were made for close-packed and expanded D_2O-moderated cores. Spert III. The effects of coolant flow on the reactor response to reactivity changes were studied over the water velocity range of 0 to 18 ft/sec for initial asymptotic periods of 500 to 10 msec. The post-burst equilibrium power is proportional to the flow rate, and 18 ft/sec flow velocity eliminates the initial power peak for power excursions of period >100 msec. Engineering. D_2O losses in Spert II are discussed. Burnout heat flux calculations were made for Spert III including the effects of two-phase flow. Hydraulic tests of Spert type-D fuel assembly channel flow distributions indicate that, for a Spert IV 20-assembly configuration, the maximum deviation from average channel flow is 14% for upflow and 6% for downflow. (D.L.C.)

25592 (IDO-16687) QUARTERLY TECHNICAL REPORT, SPERT PROJECT, OCTOBER, NOVEMBER, DECEMBER, 1960. F. Schroeder, ed. (Phillips Petroleum Co., Atomic Energy Div., Idaho Falls, Idaho). Contract AT(10-1)-205. 19p.

Spert I. Tests of fuel plates for investigation of reactivity-compensating mechanisms are described. In-pile tests of low-enrichment UO_2 fuel rods with and without cladding penetrations for the thermocouple installations indicate that the penetrations lead to rod rupture. Spert II. The ratio of the prompt neutron lifetime to the effective delayed neutron fraction was analyzed to be 0.11 sec for an expanded D_2O core. Measurements of the neutron flux and void coefficient of reactivity as functions of core position are reported. Spert III. The results of data analysis for the experiments on the effects of system pressure and coolant flow rate on power excursions are reported. Rippling and bowing of the clad fuel plates were observed following power excursion tests, and blisters were formed on the outside fuel plates of three fuel assemblies. Engineering. Channel flow distributions were measured for a Spert III dummy fuel assembly in the ETR hydraulic test facility. For a total assembly flow rate of 400 gpm, corresponding to 20,000-gpm flow in Spert III, the maximum flow deviation from the mean is 19.6%. (D.L.C.)

25593 (IDO-16693) QUARTERLY TECHNICAL REPORT, SPERT PROJECT, JANUARY, FEBRUARY, MARCH, 1961. F. Schroeder, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Contract AT(10-1)-205. 26p.

Spert I. The UO_2-core experimental program for reactor kinetics investigations is described and some static reactor measurements reported. Checks of the compensated ion chambers used as neutron detectors in the large-amplitude, low-power oscillator tests show that the anomaly in the oscillator test data is not due to faulty operation of the chambers. Sert II. The first self-limiting power-excursion test with a D_2O-moderated reactor was performed in Spert II. The data indicate that the behavior is that of the long-lifetime system and that steam formation is an important mechanism for quenching of the initial burst. For tests with periods of 70 to 50 msec, transient pressure differentials in the core are sufficient to deform fuel plates. Spert III. The magnitude of calculated reactivity compensations are found to be only half that of the experimental results. The reactor response to reactivity additions which are linear functions of time (ramp rate) was studied and compared with step-wise additions. Engineering. The thermowells in Spert III which were found to have natural resonant frequencies in close proximity to the frequency of primary pump impellers were replaced with shorter thermowells. A hydraulic fatigue test of a 18-plate type-D fuel assembly resulted in no damage after 220 hr. (D.L.C.)

25594 (NAA-SR-6039) DESIGN CRITERIA AND EXPERIENCE IN NUCLEAR FUEL IRRADIATIONS. D. G. Harrington (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 15, 1961. 56p.

The use of test reactors for nuclear fuel irradiation studies is a relatively new, but expanding, research endeavor. The criteria for designing in-pile nuclear fuel experiments are described. Interrelated heat transfer, nuclear, safety, mechanical, and administrative problems are considered. Graphs are presented which allow rapid estimation of 16 design criteria for preliminary planning purposes. Illustrations of the experience accumulated are given, where applicable. (auth)

25595 (NAA-SR-Memo-2805) REACTIVITY IN SRE OF THE BETTIS ALLOYS. J. J. McClure (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 21, 1958. 4p.

The reactivities of several U–Nb–Zr alloys in the Sodium Reactor Experiment are compared with that of 2.8% enriched U fuel. The alloys considered have the following compositions: 15% Nb–70% U–15% Zr; 12% Nb–82% U–6% Zr; and 6% Nb–82% U–12% Zr. Each alloy is studied at U enrichments of 3, 7, and 11%, and the alloy enrichments necessary to give the same reactivity as the 2.8% enriched U fuel are found by interpolation. (T.F.H.)

25596 (NAA-SR-Memo-6270) STRUCTURAL EVALUATION OF HNPF U–MO FUEL ELEMENTS. F. J. Waters (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 12, 1961. 49p.

A structural evaluation is presented of the Hallam Power Reactor fuel elements. The fuel rod spacer examined is an interim design, but the final spacer is considered to be adequately represented by the analysis of the interim design. Loading of the spacer is considered at temperatures up to 600°F. The maximum stress in the hanger rod is found to be 4700 psi. Creep in the fuel rod cladding from internal pressure is predicted to be 5.2% after 48 months of operation, based on a predicted volumetric growth of 15% caused by irradiation. Data indicate that the actual volumetric growth is only 6%, so that the predicted results are quite conservative. (T.F.H.)

25597 (NAA-SR-Memo-6285) PROPOSED EXPERIMENTS RELATED TO BURNUP. L. S. Beller (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 2, 1961. 10p.

A method is proposed by which the conversion ratio, resonance escape probability, and burnup in a slightly enriched reactor may be found from experimental measurements. The method is based on the ability to measure both the fission product activity and Np activity in a single sample of reactor-enrichment material. (auth)

25598 (ORNL-3145) A STUDY OF FISSION PRODUCT TRANSPORT MECHANISMS IN HIGH TEMPERATURE GAS-COOLED REACTOR FUEL ELEMENTS. A. R. Saunders (Oak Ridge National Lab., Tenn.). July 13, 1961. Contract W-7405-eng-26. 35p.

The experimental work on the diffusion of fission products in graphite matrices at high temperatures is reviewed and the possible mechanisms of mass transport are discussed. Preliminary data are given on diffusion in these systems. It is shown that the rates of diffusion for fission products introduced by a recoil process into the moderator lattice can be correlated based on a random walk solid state diffusion model. An expression is derived for the coefficient of diffusion in terms of the lattice parameters giving the coefficients of diffusion for different atomic species as an exponential function of the atomic radii. The possibility of other controlling mechanisms above 1000°C and the effect of carbide formation and other reactions is evaluated. (auth)

25599 (WADD-TR-60-422) COMPARISON OF NUCLEAR REACTOR PARAMETERS FOR USE WITH THE HELIUM BRAYTON CYCLE AND WITH THE POTASSIUM RANKINE CYCLE. Irving A. Peltier, John E. Brooke, Harry M. Mitchell, and Charles Martel (Wright Air Development Div. Propulsion Lab., Wright-Patterson AFB, Ohio). Sept. 1960. 62p. (AD-249394)

A discussion is given of parameters affecting the size of small, fast nuclear reactors. The electric power in relation to reactor size for a helium Brayton cycle is compared with that for a potassium Rankine cycle. In a flat power-density distribution in a cylindrical reactor core, the potassium-cooled reactor is slightly larger than the helium-cooled reactor for any given coolant volume fraction. The power that a reactor may deliver for a given size depends strongly upon the radius of the holes through which the coolant passes. For small hole radii (0.1 centimeters) in the potassium-cooled reactor, thermal stress limits the power the reactor may deliver. But although thermal stress generally limits the power of the helium-cooled reactor, a portion of its power range may be limited by maximum permissible wall temperatures of the coolant passage. For larger hole radii (0.3 centimeters), thermal stress still limits the potassium-cooled reactor; but wall temperature limits the helium-cooled reactor. Taking into account thermodynamic efficiency, the potassium-cooled reactor can deliver more power for a given reactor size if the coolant passage holes are large. However as the coolant passage holes are made smaller, the helium-cooled reactor improves faster than the potassium-cooled reactor. For coolant holes of 0.1 centimeter radius, the helium reactor can deliver more power for a given size than the potassium reactor. In any case, thermal stress and wall temperature are the only limiting factors in the electric power range from 0 to 10 megawatts. Therefore, the most

desirable condition is to have the coolant passage holes as small as practical. (auth)

25600 A CRITERION FOR OPTIMIZING THE REACTOR FUEL ELEMENT GEOMETRY. Zoran Zarić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 11: 93-103(Mar. 1961). (In English)

A criterion on the basis of which one can optimize the reactor fuel element geometry is presented. The criterion is based on a maximum net electrical power which, for the given reactor parameters, can be obtained from the unit core volume without exceeding the definite value of the relative pumping power and the coolant velocity. On the basis of the derived expressions diagrams are plotted, for geometries to be compared, of the core effective power density in relation to the reactor dimensions and the coolant flow area in which curves of the optimal effective power density are determined. By comparing these curves one can determine the optimal fuel element geometry. (auth)

25601 COOLANT PURIFICATION AND pH CONTROL FOR LOW pH, RECIRCULATING WATER COOLED REACTORS. Thomas F. Demmitt (General Electric Co., Richland, Wash.). Ind. Eng. Chem., 53: 642-4(Aug. 1961).

High-temperature, water-cooled nuclear reactors may require neutral, basic, or acidic coolants depending on the materials of construction and the operating conditions. This study was undertaken to obtain information coolant quality control operations in systems using low pH coolants. Ion exchange resin regeneration procedures were evaluated, and tests were conducted in both in-reactor and out-of-reactor systems. Reactors can be operated successfully under low pH conditions, although the coolant total solids concentration and activity level may be somewhat higher than in neutral or high pH systems with comparable operating conditions. (auth)

25602 CREEP BUCKLING OF STACKED FUEL ELEMENTS. W. S. Blackburn (C. A. Parsons & Co., Ltd., Newcastle-upon-Tyne, Eng.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 14: 1-8(Apr. 1961). (In English)

Equations are deduced from which the bow in a rod forming part of an approximately vertical, pin-jointed column may be determined when there is a slight tilt and initial bow in the rod and if the creep of the material under an applied load is known. The effects of the distributions of the weight and temperature are included. Using the experimentally determined form of the creep law for uranium being thermally cycled through ±10°C, values are obtained for the time for uranium rods stacked approximately vertically in a channel to press tangentially against the side. (auth)

25603 ACHIEVING HIGH BURN-UP IN FAST REACTORS. L. R. Blake (Dounreay Experimental Reactor Establishment, Caithness, Scotland). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 14: 31-48(Apr. 1961). (In English)

A theory is proposed that relates irradiation swelling in metal fuel with burn-up. The theory is used to predict fuel element behavior under various fast reactor conditions. Agreement of the theory with known behavior is sufficient to substantiate the general conclusion that fission-product gas accumulation is chiefly responsible for swelling. It appears to be possible only to reduce and accommodate such swelling. Based on this principle, a fast reactor fuel element is suggested using unalloyed uranium, with substantial void-space, in a strong can. This element should be capable of 4 per cent average burn-up at 700°C center temperature under practical fast reactor conditions, which should be sufficient to ensure economic power. With oxide fuel it appears that, in order to satisfy the essential safety and economic requirements in a fast reactor, it is also necessary to incorporate considerable voidage in the fuel and to employ a strong can; safety requirements could also lead to double-canning. Such an arrangement could possibly attain 10 per cent burn-up, which is comparable to 4 per cent with metal fuel. A cermet of UO_2-PuO_2 dispersed in uranium metal, in a strong can and with void space in the fuel, appears to be a suitable way of combining the good properties of both oxide and uranium fuel, and could result in a high burn-up fuel for fast reactors, though its behavior is more uncertain to predict. (auth)

25604 ECONOMIC CONSEQUENCES OF DESIGN VARIATIONS OF WATER REACTOR FUEL ELEMENTS. R. J. Rickert (Combustion Engineering, Inc., Windsor, Conn.). p.207-40 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

Several fuel and cladding variations are discussed with respect to their effects on the fuel cycle economics of light water moderated, heterogeneous reactors utilizing low enrichment uranium dioxide fuel clad in either stainless steel or Zircaloy tubing. Comparisons of stainless steel and Zircaloy, the effect of reducing tube wall thickness, the influence of dimensional tolerances, and the value of using annular or cored pellets are included. (auth)

25605 A LOW-COST FUEL ELEMENT FOR WATER-COOLED REACTORS. S. Aas (Institutt for Atomenergi, Kjeller, Norway). p.241-52 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

Calculations for water cooled reactors in general show that fuel depletion and fabrication cost are two-thirds of fuel cycle cost. Thus there is a great incentive to lowering fabrication cost. This can be done by using cheaper canning materials, neutron economy permitting, simpler design, etc. A fuel element design in which thin-walled single-length stainless steel tubes are used as canning material is described and discussed. Six of these tubes filled with UO_2 as fuel material are put together to form a cluster. A limited number of such elements was manufactured and will be used as spikes in the Halden Boiling Water Reactor. Apart from this reactor test, dummy elements are being tested in out-of-pile loops to investigate the feasibility of the design. (auth)

25606 RESEARCH AND DEVELOPMENT PROPOSAL FOR A FUEL ELEMENT MADE UP WITH URANIUM OXIDE GRAINS AND A LEAD MIXTURE CONTAINED IN A SAP TUBE. L. Biondi (Nuclear Dept., Montecatini, Milan). p.319-33 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 2." London and New York, Academic Press, 1961. (In English)

A sketch and a suggestion for a line of research on an advanced type fuel element are given. The element consists of a SAP tube filled with suitable grains of uranium oxide and lead. It is foreseen that the lead is liquid in operation. The features and the behavior of such a fuel element have been theoretically examined: thermal conductivity, outer heat exchange surfaces, mixture stability, fission gas release, compatibility of the materials in contact, and nuclear safety characteristics. (auth)

25607 SAFE OPERATION OF CRITICAL ASSEMBLIES AND RESEARCH REACTORS. (International Atomic Energy Agency, Vienna). Safety Series No. 4. 1961. 101p. (STI/PUB/29)

The guiding principles are given for the safe operation

of critical assemblies and research reactors. Included are considerations of administrative procedures; safety in design and construction; commissioning of critical assemblies and research reactors; staff training, qualifications, and experience; operation of equipment; emergency procedures; and facility use. The detailed application of this manual to a hypothetical research reactor is described. (N.W.R.)

25608 SYSTEM KINETICS. T. A. Welton (Oak Ridge National Lab., Tenn.). p.309-26 of "Proceedings of Symposia in Applied Mathematics, Vol. XI. Nuclear Reactor Theory, 1961."

The stability criteria for the design of an aqueous homogeneous reactor, which requires economic power generation, are theoretically and experimentally presented. Described are the thermal and acoustical instabilities. The thermal instabilities consist of a single relatively low frequency oscillation that is added to the system by the presence of nuclear power generation and the concomitant reactivity changes produced by thermal expansion. Acoustical instabilities are generally relatively high frequency oscillations, with the lowest lying mode first showing instability. Thermal instabilities are associated with uniform reactor density changes. An example is presented using the kinetics discussed. (N.W.R.)

25609 REACTORS. (to United Kingdom Atomic Energy Authority). British Patent 873,365. July 26, 1961.

A liquid-cooled reactor is described which has means for removing fuel rods from its core. The means comprises a coffer dam assembly with a lead coffin which is lowered on the reactor top above the fuel rod to be withdrawn; the fuel rod is then raised into the coffer dam. Other details of the reactor are described, especially its control and safety rod systems. (D.L.C.)

25610 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Derek Randall Smith, Geoffrey John Bealey, and Roderick Sorlie McKean (to A.E.I.-John Thompson Nuclear Energy Co. Ltd.). British Patent 873,369. July 26, 1961.

In refueling reactors during operation, there is considerable force on the remaining fuel elements in a fuel channel being unloaded due to coolant flow. This force may be reduced by by-pass passages provided in the fuel channel, and several possible passage designs are described. (D.L.C.)

25611 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Harry Hughes (to United Kingdom Atomic Energy Authority). British Patent 873,370. July 26, 1961.

A reactor fuel plate is described having a 0.05-in. thick beryllium sheath which can accommodate irradiation swelling despite its low ductility. The sheath is of such dimensions that it overlaps the fuel plate by 0.5 in., and the end 0.15 in. is welded either together with a space between the plate and weld or to a plug with a clearance between the plug and the sheath. Most of the swelling is then accommodated by spreading of the sheath sheets. (D.L.C.)

25612 IMPROVEMENTS IN AND RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Hugo Heinrich Ludolf Ritz and Edward Rae Elliott (to C. A. Parsons & Co. Ltd.). British Patent 873,552. July 26, 1961.

A fuel element is designed so that the coolant follows a helical path for improved heat transfer without the aid of fins. The fuel element comprises a plurality of spaced tubes containing fuel arranged to form a tubular framework and supported by a central member which forms separate flow channels. Two versions of the design are described, one of which has the tubes twisted helically around the central member while the other has a helical central member. (D.L.C.)

25613 CLUSTER ARRANGEMENT OF FUEL ELEMENTS IN AN ATOMIC REACTOR. Jacques Andre Stohr and Maurice Gauthron (to Commissariat a l'Energie Atomique). British Patent 873,594. July 26, 1961.

A cluster arrangement of fuel elements is described in which the cluster is held together by a plurality of tube groups spaced along the cluster. Each tube group consists of parallel tubes welded together at their adjacent edges and surrounded by a metal belt. The tubes engage in the constricted parts of the fuel elements. (D.L.C.)

25614 NEUTRONIC REACTOR STRUCTURE. H. C. Vernon and A. M. Weinberg (to U. S. Atomic Energy Commission). U. S. Patent 2,986,508. May 30, 1961.

The neutronic reactor is comprised of a core consisting of natural uranium and heavy water with a K-factor greater than unity. The core is surrounded by a reflector consisting of natural uranium and ordinary water with a K-factor less than unity. (AEC)

25615 FUEL ELEMENT FOR A NUCLEAR REACTOR. J. G. Duffy, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,986,509. May 30, 1961.

A lattice type fissionable fuel structure for a nuclear reactor is described. The fissionable material is formed into a plurality of rod-like bodies with each encased in a fluid-tight jacket. A plurality of spaced longitudinal fins are mounted on the exterior and extend radially from each jacket, with a portion of the fins extending radially beyond the remainder of the fins. A collar of short length for each body is mounted on the extended fins for spacing the bodies, and adjacent bodies abut each other through these collars. Should distortion of the bodies take place, collapse of the outer fins is limited by the shorter fins, thereby insuring some coolant flow at all times. (AEC)

25616 FUEL ELEMENT CONSTRUCTION. L. R. Zumwalt (to U. S. Atomic Energy Commission). U. S. Patent 2,994,656. Aug. 1, 1961.

Fuel elements having a solid core of fissionable material encased in a cladding material are described. A conversion material is provided within the cladding to react with the fission products to form stable, relatively non-volatile compounds thereby minimizing the migration of the fission products into the coolant. The conversion material is preferably a metallic fluoride, such as lead difluoride, and may be in the form of a coating on the fuel core or interior of the cladding, or dispersed within the fuel core. (AEC)

25617 FISSILE MATERIAL AND FUEL ELEMENTS FOR NEUTRONIC REACTORS. Burton E. Shaner (to U. S. Atomic Energy Commission). U. S. Patent 2,996,443. Aug. 15, 1961.

The fissile material consists of about 64 to 70% (weight) zirconium dioxide, 15 to 19% uranium dioxide, and 8 to 17% calcium oxide. The fissile material is formed into sintered composites which are disposed in a compartmented fuel element, comprising essentially a flat filler plate having a plurality of compartments therein, enclosed in cladding plates of the same material as the filler plate. The resultant fuel has good resistance to corrosion in high temperature pressurized water, good dimensional stability to elevated temperatures, and good resistance to thermal shock. (AEC)

25618 FUEL ELEMENT CONSTRUCTION. Massoud T. Simnad (to U. S. Atomic Energy Commission). U. S. Patent 2,996,444. Aug. 15, 1961.

A method of preventing diffusible and volatile fission

products from diffusing through a fuel element container and contaminating reactor coolant is described. More specifically, relatively volatile and diffusible fission products either are adsorbed by or react with magnesium fluoride or difluoride to form stable, less volatile, less diffusible forms. The magnesium fluoride or difluoride is disposed anywhere inwardly from the outer surface of the fuel element container in order to be contacted by the fission products before they reach and contaminate the reactor coolant. (AEC)

Power Reactors

25619 (ACNP-6101) PATHFINDER ATOMIC POWER PLANT. FILTRATION OF ALUMINUM CORROSION PRODUCTS PRODUCED IN HIGH-TEMPERATURE, HIGH-PURITY WATER SYSTEMS. J. H. Noble and R. L. Davie (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). May 1, 1961. For Northern States Power Co. and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 56p.

Filter tests were conducted to determine the most suitable filter for removing large quantities of aluminum corrosion product (boehmite) from reactor water. Filters tested included the following: wire-wound, sintered filter elements, sintered ceramic filter elements, cotton string-wound filter elements, felted-cotton filter elements, cation resin, adsorption resin, diatomaceous earth precoat filter, and a wood-cellulose precoat filter. Parameters measured were flow rate, filter-influent and -effluent boehmite concentration, pressure drop, and final filter load. The pressure drop and efficiency of the filters was correlated with boehmite load. Boehmite deposits on filters as a non-porous gelatinous cake, and causes a rapidly increasing pressure drop. Tests indicate that the optimum load with filter elements and precoat filters is achieved at a pressure drop of 25 psi. Very little additional load can be obtained by operating to a higher pressure drop. Of the filters tested, the precoat filter and 40 to 60 mesh cation resin were the more effective in removing boehmite. The efficiency of the precoat filter was in excess of 99%, and the efficiency of the cation resin was for the most part in excess of 95%. For various reasons, the other filters were eliminated from final consideration. The test program and available literature indicated that an element type precoat filter using wood cellulose as the precoat media would be most suitable for the proposed application. (auth)

25620 (ANL-6076) DESIGN OF THE ARGONNE LOW POWER REACTOR (ALPR). N. R. Grant, E. E. Hamer, H. H. Hooker, G. L. Jorgensen, W. J. Kann, W. C. Lipinski, G. C. Milak, A. D. Rossin, D. H. Shaftman, A. Smaardyk, and M. Treshow (Argonne National Lab., Ill.). May 1961. Contract W-31-109-eng-38. 269p.

A description is given of the design of a prototype "packaged" nuclear power plant. The purpose of the plant is to alleviate fuel oil logistics and storage problems posed by remote auxiliary DEW Line radar stations north of the Arctic Circle. The ALPR (redesignated SL-1) is a 3 Mwt, heterogeneous, highly enriched uranium-fueled, natural-circulation boiling water reactor, cooled and moderated with light water. Steam at 300 psig, dry and saturated (421°F) is passed directly from the reactor to a conventional turbine-generator to produce electric power (300 kw nominal) and space-heating (400 kw) requirements consistent with rigid mechanical and structural specifications prescribed by the military, and dictated by the extreme geophysics prevailing at the ultimate site. The overall design criteria emphasize: simplicity and reliability of operation and maintenance, with minimum supervision; minimum on-site construction; maximum use of standard components; limited water supply; utilization of local gravel for biological shielding; transportability by air lift; and nominal 3-year fuel operating lifetime per core loading. The "packaged" concept is incorporated for the initial erection. The plant is not designed for relocation. The design criteria for the prototype necessitate special features. The fuel plates are clad with an aluminum-nickel alloy (X8001). Burnable-poison (B^{10}) strips are mechanically attached to the fuel assemblies to compensate the excess reactivity required for a nominal 3-year core operating lifetime. The control rods are actuated by rack-and-pinion drive extensions which incorporate rotary seals. Fuel exchange is accomplished without the removal of the pressure vessel head. The electrical power generated is used to operate plant auxiliaries; the "net electric power" is dissipated by resistors. The hot water for space heating is heated in a heat exchanger by 20-psig steam, use being made of the latent heat of vaporization, and all the heat is dissipated by a finned-tube, air-cooled heat exchanger. (auth)

25621 (ANL-6387) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT [FOR] JUNE 1961. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. July 15, 1961. 69p.

Water Cooled Reactors. The irradiation performance of a prototype EBWR Core I fuel plate in a high-pressure water loop is reported. Preliminary data on decontamination of 304 stainless steel by oxalic acid-hydrogen peroxide are presented. EBWR cores IA and II and EBWR operation are discussed. Installation and testing of BORAX V reactor components are reported. Sodium Cooled Reactors. Fission and reactivity measurements are reported for ZPR-III fuel assemblies 36 and 22. Progress on the ZPR-VI and ZPR-IX is outlined. Fabrication of EBR-I Mark IV core, construction of EBR-II, and development of EBR-II components are discussed in detail. Reactor Safety. Studies of the reactor of U and Al with steam and water are described. Results are presented for TREAT reactor transients performed on fuel pins of UO_2 clad with 304 stainless steel and submerged in water. Preliminary data are presented for the ignition temperature of Zr. Fast reactor safety studies under way are outlined. Nuclear Technology. Neutron differential elastic scattering cross sections are presented for Th and Fe at 0.5 to 1.6 Mev. Reactivity measurements in the ATSR are reported. Operating conditions for ZPR-VII critical conversion experiments are outlined. Results of corrosion of Al powder tubing in water at 290 and 360°C and of Zr alloys in steam at 540°C are discussed. Heat content tables are presented for pure U and uranium–5 wt % fissium at 0 to 1200°C, and heats of transformation and fusion are also given. Some results of studies of the properties of PuC are discussed. Nondestructive testing methods are discussed. Various projects in reactor materials and components development and heat engineering are described. A large number of studies was conducted on separation of uranium from fuel elements, especially by fluorination. Reactions of PuF_6 with various inorganic solids were studied, and the G value for radioinduced PuF_4 production from PuF_6 was determined. Operating results are presented for the two-step fluid bed process in which UF_6 was converted into UO_2F_2 by steam hydrolysis and the UO_2F_2 subsequently reduced to UO_2. Pure U_3Si_2 was obtained by reaction of stoichiometric amounts of U and Si at 800°C. ThO_2 was

found to be reduced to the metal in 2 hr at 750°C by 5 wt % Mg–Zn in a salt flux. Equations are given for the solubilities of Sc and Fe in liquid Cd. Work on U–Zn alloys and on distribution of U between liquid Pb and liquid Zn are discussed. Some advanced reactor concepts are discussed. (D.L.C.)

25622 (APAE-Memo-290) TASK XII ANALYTICAL REPORT—SM-1 TRANSIENT ANALYSIS BY ANALOG COMPUTER METHODS. J. A. Barrett (Alco Products, Inc., Schenectady, N. Y.). May 26, 1961. Contract AT(30-3)-326. 73p.

The voltage and frequency response of selected SM-1 plant system parameters to step load changes was analyzed using analog computer measurements. The analog model was that developed for analysis of the SM-2 design. The approach to the analysis, formulation of the model, and analog recordings are presented. The data will be used to prove reliability of the analog model by comparing analog data with test data to be taken at SM-1. (auth)

25623 (BAW-1206) FEASIBILITY STUDY OF METHODS FOR DETERMINATION OF KINETIC STABILITY IN THE NMSR. J. M. Funderburg and L. G. Barrett (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Aug. 1960. 36p.

Presented is a review of the theoretical studies and analogue simulation studies of the NS Savannah power system which predict that the NMSR is a stable reactor under normal and some accidental operating conditions. Investigation indicates that of possible measurements which may be performed on shipboard to determine the NMSR stability experimentally, a pile noise analysis would be the most desirable. This would give a semi-quantitative evaluation of the power coefficients, and would involve a minimum of reactor time. Two approaches are discussed: the direct measurement of pile noise performed for frequencies above about 1 cps; and autocorrelation techniques which could be supplemental for lower frequencies and which would conserve reactor time at the expense of calculation time. If the noise analysis exhibited any tendency toward instability, then a pile oscillator analysis could be used to obtain a precise measurement of the total transfer function. The NS Savannah rods can be oscillated suitably for frequencies below 1 cps. Final analysis of the detailed transfer function would aid in discovering the cause of any such instability. (auth)

25624 (BMI-1526) NUMERICAL RESULTS FOR EGCR MODERATOR-ELEMENT STRESS PROBLEMS. Lewis E. Hulbert and Robert F. Redmond (Battelle Memorial Inst., Columbus, Ohio). July 3, 1961. Contract W-7405-eng-92. 138p.

A detailed presentation is made of the thermal stresses calculated for the moderator elements in the Experimental Gas-Cooled Reactor. These results are discussed and some conclusions are presented. This report complements a previous report, BMI-1503, which defines the problems and discusses the methods of solution. (auth)

25625 (BNL-619) LIQUID METAL FUEL REACTOR. FOUR-INCH UTILITY TEST LOOP DESIGN, CONSTRUCTION, OPERATION, AND EXPERIMENTAL RESULTS. K. C. Hoffman, R. J. Isler, C. H. Scarlett, and G. A. Schoener (Brookhaven National Lab., Upton, N. Y.). July 14, 1960. 50p.

A 4-in., schedule 40, 2¼% Cr – 1% Mo pipe loop to circulate liquid Bi was designed, constructed, and operated in order to obtain information required for the design of a liquid metal fuel reactor experiment. The 4-in. utility test loop consisted of two pumping circuits, each designed to carry 360 gpm of fluid. The fluid in the primary circuit was a solution of small amounts of U, Zr, and Mg in Bi. The secondary fluid was a solution of Zr and Mg in Bi. The heat was supplied by an oil fired furnace and ultimately removed by an air blast cooler. The design power level was 5 Mw. The facility was constructed in accordance with stringent fabrication specifications and operated successfully for a total of 1700 hr. During operation, problems of a developmental nature were encountered and satisfactorily resolved. (auth)

25626 (CEA-1907) PROTECTION DE L'INTERVENTION SUR LE CANAL W.19.E DE LA PILE G.2. (Protection for Work on Channel W.19.E of the Pile G.2). J. Rodier and J. -Ph. Chassany (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 22p.

Cartridges became stuck in one of the channels of G2 because of a canning burst and attempts at unloading. They were removed from the front. Contamination was kept under control by the use of vinyl protective equipment, the working areas being defined, and corresponding clothing cartridges kept the doses absorbed down to a negligible level. As a result of this very strict discipline, there was no spread of contamination nor any irradiation accident in the course of this work, which lasted about a month and involved 3,635 trips to the area. (auth)

25627 (DLCS-2110140) PERIODIC PRIMARY PLANT LEAK RATE TEST. CORE 1, SEED 2. Test Results T-641102. (Duquesne Light Co., Shippingport, Penna.). First issue, June 14, 1961. 18p.

Tests performed on the Shippingport PWR to determine the magnitude and sources of primary coolant water leakage from the reactor coolant system are described. Two of the pressurizer relief valves are found to account for 80% of the total leakage of 56 gal/hr from six pressure relief and reactor relief valves. Other valves are found to have insignificant leakage. The total primary coolant water leakage is found to be 26 gal/hr. (auth)

25628 (DLCS-2110141) PERIODIC REACTOR PLANT LEAK RATE TEST. CORE 1, SEED 2. Test Results T-641102. (Duquesne Light Co., Shippingport, Penna.). First Issue, June 14, 1961. 16p.

Tests were performed on the Shippingport PWR to determine the magnitude and location of coolant system leakages. The total leakage from pressurizer relief and reactor relief valves was 62.1 gal/hr. The total plant leakage was 19.3 gal/hr. (T.F.H.)

25629 (DLCS-2390401) PERIODIC WASTE DISPOSAL SYSTEM MATERIAL BALANCE TEST. CORE I, SEED I. Test Results T-641317. Section 1. (Duquesne Light Co., Shippingport, Penna.). First issue, June 14, 1961. 79p.

Tests were performed to determine the adequacy of storage facilities and operating procedures of the Shippingport PWR waste disposal system during a reactor refueling operation. Problems associated with the liquid waste evaporator and the various storage tanks were outlined. The activities of the wastes expelled to the reactor effluent channel and the Ohio River were compared with the design activities. (T.F.H.)

25630 (DLCS-3550401) STEAM GENERATOR TEST, (1A LOOP FOSTER-WHEELER STEAM GENERATOR). CORE 1, SEED 2. Test Results T-643701. Section 4. (Duquesne Light Co., Shippingport, Penna.). First issue, Apr. 17, 1961. 31p.

Tests were performed on the 1A loop of the Shippingport PWR steam generator, in order to determine the existence

of steam blanketing in the heat exchanger section of the generator, to obtain data on the operating and chemical characteristics of the generator, and to determine the effects of varying the sample flow rates on the boiler sample conductivity measurements. (T.F.H.)

25631 (DP-599) HEAVY WATER COMPONENTS TEST REACTOR, SAVANNAH RIVER PLANT. Composite Concrete–Steel Containment Vessel Engineering Considerations. H. W. Bellas (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). June 1961. Contract AT(07-2)-1. 50p.

Design and construction features of a composite concrete-steel containment vessel are described and illustrated. Included are a detailed description of design considerations and criteria, physical tests made on concrete to determine adaptability, procedure and results of containment vessel pressure tests and recommended improvements for future design and construction. (auth)

25632 (DP-615) HEAVY WATER MODERATED POWER REACTORS PROGRESS REPORT, APRIL 1961. R. R. Hood and L. Isakoff, comps. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). June 1961. Contract AT(07-2)-1. 28p.

Construction of the HWCTR was approximately 70% complete. Localized hydrogen attack on Zircaloy was identified tentatively as the principal cause of the sheath failures that occurred during Savannah River irradiation tests of mechanically compacted tubes of Zircaloy-clad uranium oxide. The most probable source of the hydrogen is believed to be water vapor, which will be removed from the oxide in future tests. The irradiation testing of one thin-walled 2-in.-diameter tube of unalloyed uranium clad with Zircaloy continued at Savannah River; irradiation tests were started on four 1-in.-diameter tubes of this material. Experimental data were obtained on the heat transfer limits for a bundle of seven rods cooled by forced flow of boiling water. (auth)

25633 (DP-625) HEAVY WATER MODERATED POWER REACTORS. Progress Report [for] May 1961. R. R. Hood, comp. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). July 1961. Contract AT(07-2)-1. 32p.

Fabrication of the reactor vessel for the Heavy Water Components Test Reactor was completed during May, and the vessel was subjected successfully to a hydrostatic test. At Savannah River, low temperature irradiations of five Zircaloy-clad tubes of unalloyed uranium were concluded, and postirradiation examinations of the tubes were started. Four extruded joints of Zircaloy and stainless steel were cold worked as much as 40% without apparent damage to the interface of the two materials. In burnout tests with boiling water at 1000 psi, a higher heat flux was obtained for a 7-rod assembly having spacing wires spirally wrapped on the rods than for an assembly having intermittent protuberances as spacers. In experiments on the stability of boiling water flow, the amplitude of boiling flow fluctuations was tentatively correlated with exit steam quality and with the inlet flow resistance. (auth)

25634 (GA-1982) 40-MW(E) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending December 31, 1960. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Contract AT(04-3)-314. 190p.

Developments in the High Temperature Gas Cooled Reactor (HTGR) program are reported. Studies continued on the preparation of (Th, U)C_2 particles. One technique was used to produce particles with no detectable oxide impurity. These particles were more dense than those prepared by sintering. The fabrication of coated fuel particles and evaluation of their properties continued. Techniques were developed for producing fuel compacts containing these coated particles. Low-permeability graphite tubes of the full HTGR diameter and of a length of 4 ft were produced. The second series of GA-309 capsule irradiations was started using a new gas-sampling system. Preliminary results on compacts made from pyrolytically coated fuel showed a mean holdup time for fission products of about 500 hr. Construction of the in-pile loop was completed. The development of codes for nuclear calculations on the HTGR core was continued. The half-scale flow model was completed. A study is being made to determine the best means of generating smoke for use in visual studies of flow in the model. A test was run with a 19-tube cluster of full-scale, simulated fuel elements to determine whether the flow of coolant gas could induce vibration. Not only could no such vibration be detected, but when the elements were forced by an exciter to vibrate at their natural frequency, the gas stream had a definite damping effect. A series of measurements was made to determine the worth of a control rod and another series to determine boron diffusion in graphite as a function of temperature. A study was made of the emergency cooling of the reactor vessel, the reflector seal, and pressure-drop in the vessel. Design effort on the prototype control-rod drive resulted in the completion of the basic system layouts and the initiation of drawings of the components. The test rig to determine dynamic behavior and wear characteristics of various ball-screw configurations was completed. A decision was made to eliminate the fuel-loading machine and to employ the charge machine to load new fuel elements into the reactor. (auth)

25635 (GEAP-3492) A STUDY OF THE EFFECTS OF SHIPS MOTION ON FREE-SURFACE STEAM-WATER SEPARATION. H. E. Weber and L. R. Glicksman (General Electric Co. California Advanced Propulsion Systems Operation, San Ramon, Calif.). July 15, 1960. For General Electric Co. Atomic Power Equipment Dept. Contract AT (04-3)-189. 38p.

A study of the liquid–vapor separation problem was undertaken. Particular attention was paid to the carryover problem and carryunder problem. Expressions or methods for evaluating the liquid carryover were obtained. The same was done for the vapor carryunder problem; i.e., the vapor carried along with the liquid in the return line from the separator. A flow model was established and the analysis for the carryover problem imposed the condition that the shear and liquid gravitational forces balanced at the liquid-vapor interface with zero liquid velocity. Also, the flow over the bubbles at the liquid-vapor interface was laminar so that the shear stress was inversely proportional to the liquid film thickness. For the carryunder problem, the vapor bubble bouyancy and drag forces were equated to determine permissible liquid velocities in the downcomer. (auth)

25636 (GEAP-3575) ANALOG SYSTEMS FOR THE T7 FLUX TRAP CORE. B. R. Bullard and R. M. Kendall (General Electric Co. Flight Propulsion Lab., Dept., San Ramon, Calif.). July 7, 1960. For General Electric Co. Atomic Power Equipment Dept. Contract AT(04-3)-189. 49p.

Analog computer studies were conducted using three different models of the T7 flux trap core subjected to a variable acceleration representing the effect of ship's motion.

One model was the batch model developed previously. The ther two were flow models having equations of like form ut using a different method of combining the heated two-hase length and the riser length. The original model com-ines the two sections on the basis of length. The modified low model combines the two sections on the basis of the riving head developed across each. The three models were ompared in the steady state with an apparent step change n acceleration to 1.5g. The results were in close agree-ient, the batch model showing a velocity variation of 20% ompared to 17% for the modified-flow model and the vari-tions in void fraction of 24 and 30%, respectively. The ifferences are attributed to the basic differences in the odels. The steady-state model and modified core model ere compared with a harmonic excitation of ±0.55 g. At ie expected operating frequency of 0.16 cps, the transient ature of the modified flow model gives a maximum neutron lux of 158% compared to 178% for the batch model. The eaks are lower for the flow model than for the batch model t frequencies above 0.1 cps, but slightly higher below 0.1 ps. The Dome and Downcomer models were studied, ough not as extensively as the core model. The Dome odel was improved over that which was previously used y incorporating energy terms which were neglected. It was etermined that the Downcomer model can be improved by corporating in it a variable time delay, which will reduce ie peak in neutron flux which occurs at 0.04 cps. (auth)

25637 (LAMS-2538) A PRELIMINARY REPORT ON NUCLEAR ROCKET DYNAMICS AND CONTROL. R. R. Mohler and E. A. Wheatley (Los Alamos Scientific Lab., N. Mex.). Mar. 31, 1961. Contract W-7405-eng-36. 30p.

The collection of memoranda included are: (1) prelimi-ary Report on Nuclear Rocket Engine Control Systems; nd (2) A Mathematical Model to Represent the Basic ynamics of a Nuclear Rocket System. (auth)

25638 (LAMS-2539) KIWI-B SYSTEM DYNAMICS. . R. Mohler, O. A. Farmer, B. G. Strait, and E. A. heatley (Los Alamos Scientific Lab., N. Mex.). Mar. 31, 961. Contract W-7405-eng-36. 80p.

Included are a collection of preliminary studies made on ie Kiwi B systems: (1) Kiwi B Characteristic Dynamics quations; (2) A Simplified Heat Exchanger-Neutronics odel; (3) Kiwi B Reactivity Gain Compensation; and (4) An BM 704 Program to Compute Kiwi B Frequency Response. lthough some of the information is outdated, the basic aterial is applicable to present design concepts. Memo-andum (1) was written before the system included a turbo-ump. Some results of this study were reported previously. uth)

25639 (NAA-SR-Memo-3228) FUEL BURN-UP STUDY F HNPF REFERENCE CORE. R. A. Blaine (Atomics In-rnational. Div. of North American Aviation, Inc., Canoga ark, Calif.). Nov. 7, 1958. 4p.

The change of reactivity in the Hallam Power Reactor is alculated as a function of exposure, up to an average ex-osure of 8000 Mwd/t. The numbers of U^{235}, Pu^{239}, and Pu^{241} atoms, relative to the original number of U^{235} atoms, re also calculated as functions of exposure. The fuel is ssumed to be un-recycled, and the control rods are as-umed to be fully withdrawn. The effects of fission products ther than Xe and Sm are accounted for. (T.F.H.)

25640 (NAA-SR-Memo-3552) RADIAL THERMAL ND FAST NEUTRON FLUX DISTRIBUTIONS IN THE SO-IUM REACTOR EXPERIMENT (SRE) AND IN THE TITLE CONFIGURATION OF THE HALLAM NUCLEAR FACIL-TY (HNPF). P. J. Legendre (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 27, 1959. 30p.

The thermal neutron flux distributions for the Sodium Reactor Experiment and the Hallam Power Reactor radial shields are calculated by three different methods. The method giving the highest fluxes is used to calculate con-servative values of the heat generation rates in these shields. (T.F.H.)

25641 (NAA-SR-Memo-4546) STRUCTURAL ANALY-SIS OF THE BOTTOM HEAD OF THE REACTOR VESSEL. H. L. Sujata (Atomics International. Div. of North Ameri-can Aviation, Inc., Canoga Park, Calif.). Apr. 20, 1961. 15p.

The structural integrity of the bottom head of the Hallam Power Reactor vessel is studied, under normal operation and accidental transient conditions. The maximum mechan-ical stress, "elastic" thermal stress, and cumulative fa-tigue damage are calculated. It is established that the bot-tom head will not buckle or wrinkle as a result of frictional forces developed during thermal expansion of the vessel. (T.F.H.)

25642 (NAA-SR-Memo-5084) REPLACING SPENT FUEL ELEMENTS WITH NEW FUEL ELEMENTS ON THE REACTOR FUEL ELEMENT SHIELD PLUGS AT HNPF. E. C. Turner (Atomics International. Div. of North Ameri-can Aviation, Inc., Canoga Park, Calif.). Mar. 21, 1960. 23p.

The procedure followed at the Hallam Power Reactor for the replacement of spent fuel elements with new fuel ele-ments is described. The spent elements are transferred from a storage cell to a maintenance cell; the new elements are brought from a pickup cell to the maintenance cell; the new and used elements are exchanged; and the used ele-ments are transferred into shipping casks. (T.F.H.)

25643 (NAA-SR-Memo-5775) DESIGN, FABRICATION AND INSTALLATION OF SRE FUEL ELEMENT GUIDE ASSEMBLY 7519-44741. E. R. Meise and G. C. Gower (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 25, 1960. 9p.

The design, fabrication, and installation of a fuel-element guide assembly for the Sodium Reactor Experiment are de-scribed. Improvements in this assembly over other models are outlined, and recommendations for the testing of SRE core elements are presented. (T.F.H.)

25644 (NAA-SR-Memo-5996) OPTIMIZATION STUD-IES ON PASTE-FUELED FAST REACTORS. J. M. Zetter-baum and T. W. Kerlin (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 28, 1960. 21p.

The reference design is an unmoderated, sodium-cooled reactor using a paste fuel of uranium monocarbide in so-dium. The core is a cylinder 5 ft in diameter and 5 ft in height. An 18-in. thick breeding blanket surrounds the core, and an 18-in. thick graphite reflector surrounds the blan-ket. Various changes were made in the reference core to uncover any possible modifications for cost reductions and to evaluate the consequences of certain design modifica-tions which might occur. Cases were studied for variations in: fuel volume fraction in the core from 0.2 to 0.6; fertile material volume fraction in the blanket from 0.2 to 0.6; blanket thickness 3 in. to 24 in.; fuel materials of UC, U metal, UO_2, PuC–UC, Pu–U metal, and PuO_2–UO_2; and liquid carrier in the paste of Na, Sn, or Pb. (auth)

25645 (NAA-SR-Memo-6239) CONCEPTUAL DESIGN–FUEL ELEMENT SELECTION AND CORE PERFORM-ANCE. J. D. Wilde (Atomics International. Div. of North

American Aviation, Inc., Canoga Park, Calif.). Mar. 29, 1961. 49p.

A survey is made of several types of fuel elements for an OMCR-type reactor. Square and hexagonal box and circular tube configurations are considered. The fuel consists of UO_2 pins clad with finned tubing. The temperatures are limited to 850°F. Both forced convection and subcooled nucleate boiling effects are investigated. The hexagonal box fuel element is found to give performance superior to that of the other configurations. This type of element is optimized and its core performance characteristics are studied. (T.F.H.)

25646 (NMI-7240) POWER REACTOR PROGRAM. Progress Report to Savannah River Operations Office, United States Atomic Energy Commission for the Period May 1, 1961 through May 31, 1961. S. Isserow, R. W. Anderson, W. J. Richmond, and E. F. Jordan (Nuclear Metals, Inc., Concord, Mass.). June 19, 1961. Contract AT(30-1)-1565. 19p.

The successful extrusion of one copper–nickel tube and one uranium-cored tube provided assurance that the proposed change in billet design would improve the quality of the outer tubes. As a result, a demonstration set of three unalloyed uranium tubes was extruded. Preliminary evaluation indicated that the tubes will meet all specifications. Two 1-in. diameter tubes were extruded for the study of the effect of restraint on fuel swelling. (auth)

25647 (NP-10458) ENRICO FERMI ATOMIC POWER PLANT REVISED LICENSE APPLICATION. PART A. GENERAL INFORMATION AND REQUEST FOR LICENSE. PART B. TECHNICAL INFORMATION AND HAZARDS SUMMARY REPORT, VOLS. 1 THRU 6. (Power Reactor Development Co., Detroit). July 1961. 209p.

Part A contains information regarding the Power Reactor Development Company, which operates the reactor, other information required by the AEC, and the specific license application. Part B consists of 6 volumes which comprise studies of the reactor and plant design, normal operations, and commissioning operations; the system verification programs; and the reactor site and environment considerations. (T.F.H.)

25648 (RWD-RL-190) KINETIC STUDIES OF HETEROGENEOUS WATER REACTORS. Annual Summary Report 1960. (Space Technology Labs., Inc., Los Angeles). Dec. 30, 1960. For Ramo-Wooldridge. Contract AT(04-3)-165. 132p.

Work completed on the reactor safety problems of predicting the severity of possible power excursions in heterogeneous water reactors and predicting the conditions under which such reactors develop dangerous power oscillations are summarized. The experimental studies were out-of-pile and emphasized measurements of the steam void dynamics applicable to a water reactor. An idealized reactor in which thermal expansion effects were negligible and shutdown was caused entirely by steam voids was investigated. An experimental apparatus was developed for out-of-pile simulation of reactor transients and the simulation of a reactor in which thermal expansion effects do not aid reactor shutdown. It is shown that this limiting case is useful in understanding water moderated reactor behavior. Studies were continued on previous transfer function measurements. (M.C.G.)

25649 (TID-11695) MONTHLY OPERATING REPORT, FEBRUARY 1960. (Duquesne Light Co., Shippingport, Penna.). Contract AT-11-1-292. 32p.

The Station was shutdown for refueling and the Core Removal Cooling System was in operation. The 1A, 1B, and 1C reactor-coolant pumps were rotated twice. Routine sampling was limited to the Component Cooling Water System, the primary water storage tank, and the Canal Water System which were still in service. All reference water specifications were maintained in the systems except for the dissolved oxygen concentration in the primary water storage tank. Two chemical waste tanks and one surge tank were filled, tested, and processed by evaporation. Health Physics reports extensive radiation control for the protection of working personnel in the Reactor Plant Containers. Shielding in some areas was difficult because of the lack of support structures. All discharged gaseous activity during incinerator operation was below limitations for release to an uncontrolled area. Radiation intensities in the vicinity of the canal water demineralizers remained constant throughout the month. Most of the remaining reactor components previously removed from the reactor vessel were reinstalled. All of the new seed exit-water thermocouples, seed metal thermocouples, blanket exit-water thermocouples, and auxiliary seed exit-water thermocouples were installed. Reproductions are included of photographs taken of various stages of refueling operations performed on the reactor vessel head. The 48-inch butterfly valves were repaired and maintenance support for the leak test of the 1B heat exchanger was continued. Modifications were initiated in the Nuclear Instrumentation Systems. Removal of 29 valve-position indicators for repairs was begun. New faceplate indicators were installed on the Rod Control System inverters, and the AC and BD pump noise monitors were modified. Information is presented on the status of Duquesne Light Company operational training and Nuclear Power Station Training Program. (auth)

25650 (TID-11696) MONTHLY OPERATING REPORT, AUGUST 1960. (Duquesne Light Co., Shippingport, Penna.). Contract AT-11-1-292. 38p.

25651 (TID-11918) ENGINEERING EVALUATION STUDIES, HEAVY WATER MODERATED POWER REACTOR PLANTS. Quarterly Progress Report, October–December 1960. (Sargent and Lundy, Chicago). Jan. 24, 1961. Contract AT(38-1)-213. 167p. (SL-1829-2)

Studies of the corrosion of steels by water were reviewed. Additional tests were carried out to supplement existing data. An investigation of corrosion product deposition was initiated to study the deleterious effects of heat transfer and fluid flow in the primary system components. Preliminary analysis of major mechanical equipment specifications for use with heavy water plants indicated that they are not significantly different from those for light water nuclear plants. The testing program designed to quantitatively evaluate the leakage losses of heavy water from mechanical components is being continued. Test results for shaft seals indicated excellent results when the seals were operated at rated conditions. Excessive leakages occurred, however, when the seals were operated at low pressures. A program is being conducted to correlate the designs of various heavy water moderated reactor plants in the United States, Canada, and Europe. As a result of analyses and evaluations, it is expected that cost reductions for both the full-scale and prototype, boiling D_2O, pressure tube, direct cycle plants will become apparent. Data from various test were combined in an analysis to estimate the consequences of a failure of a pressure tube in the boiling D_2O prototype. It was concluded that a pressure tube failure with an opening of less than 3 $in.^2$ would not seriously damage its calandria tube. Computer programs were developed for studies underway to prepare an optimum design of each of several

D_2O moderated power reactor plant concepts with a net capacity of approximately 300 MW(e). (M.C.G.)

25652 (WANL-PR(A)-002) FEASIBILITY STUDY FOR 3MW(e) NUCLEAR THERMOELECTRIC POWER PLANT. Final Report. R. A. Clark, Jr., R. A. Doncals, W. J. Havener, R. R. Hollman, A. W. Hoppe, and G. R. Taylor (Westinghouse Electric Corp. Astronuclear Lab., Pittsburgh). Dec. 31, 1961. Contract NONR-3216(00). 276p. (AD-253750)

An outline is given of the results of a feasibility study for a power plant to produce 3 Mw(e) power output by thermoelectric conversion from a water-cooled nuclear reactor. The intended application of the plant requires unattended, deep submergence operation. A preliminary design of a reference plant is described which uses boiling natural water in a self pressurized assembly as a coolant. All coolant circulation is by thermal convection. The thermoelectric generator is heated by condensing steam with the waste heat being rejected directly to convective flow sea water. The control concept had a preliminary analysis which identifies conservative limits of stable operating conditions. A combination of temperature and augmented steam content control provides the long term adjustment for mismatch in burnable poison, depletion, fission product build up, etc. The short term control is obtained by the self-regulating temperature and steam effects. Included is a report of a materials compatibility investigation for a boiling sulfur coolant for high-temperature applications. (auth)

25653 (WAPD-MRP-92) PRESSURIZED WATER REACTOR (PWR) PROJECT TECHNICAL PROGRESS REPORT, APRIL 24, 1961 TO JUNE 23, 1961. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). 1961. Contract AT-11-1-GEN-14. 135p.

A confirmatory axial depletion study for PWR-2 Seed 1 was completed. A measurement was made of the U^{235} activation distribution in the PWR-2 mockup. Core power capability as a function of lifetime was re-evaluated using the latest physics and fuel zoning information. Tests were initiated to determine the effect of blanket fuel plate ribs on DNB and the effect of design changes in the flow baffle on core flow distribution. Calculations were initiated to establish core safety after loss of flow after the time when pump-forced circulation ceases. The effect of a revision in engineering hot channel factors applicable to compartmented plates was evaluated with results favorable to core power. The design of a secondary blanket variable orifice lock was developed and tested satisfactorily. A series of simulated fuel growth tests on seed fuel plate specimens was completed. A program to revise core manufacturing handling techniques and equipment is in progress. The isotopic content variation in the powders problem was resolved by slurry blending with Oxylene. An interim salt bath facility was utilized to manufacture V.Q. and SOAP fuel plates. SOAP wafers were successfully graphite sprayed, baked, buffed, and delivered for assembly. Long-range programs were initiated to study hafnium properties. The equipment and procedures necessary to assure proper loading of seed zones were developed. Machining of the 1D loop main coolant pump volute for Core 2 operation was completed. In-pile failures of two UO_2 fuel plates, one containing 0.160-in. thick fuel and the other containing 0.100-in. thick fuel, operating at heat fluxes of 700,000 Btu/hr-ft^2, showed a relationship between fuel temperature and swelling burnup. Conversely, these results showed that fission rate is not a parameter influencing sample failure. A similar relationship was established for the ZrO_2 + 34 and 46 wt % UO_2 fuel materials. Samples containing bulk UO_2 with about 15% internal void volume continued to show better in-pile behavior than similar samples containing fuel with essentially no void volume. Similar results were obtained on ZrO_2 + UO_2 fuel materials with about 6% internal void volume. In-pile thermal conductivity measurements on UO_2, UO_2 + 46 wt % UO_2, and UO_2 + 34 wt % UO_2 were obtained after exposures of 8 to 10 × 10^{20} fiss/cc in the temperature ranges 400 to 550°C. The UO_2 fuel decreased in thermal conductivity about 24%, the ZrO_2 + 46 wt % UO_2 decreased about 10%, and the ZrO_2 + 34 wt % UO_2 showed no change from its unirradiated value. The quality of Zircaloy-to-Zircaloy bonds in the fuel-bearing areas of pack-bonded seed oxide plates after beta-quenching was excellent. Low density (~90%) oxide fuel did not exhibit any greater tendency to waterlog than does high density fuel. The reactivity at 470°F of a core which is essentially a half section of a PWR-2 mockup was measured. The difference between the reactivity of this core and a 5 × 4 slab of the same materials was found to be the same at 470°F as it is at 77°F. This indicated the validity of extrapolating available 535°F reactivity data for 5 × 4 slabs to full core conditions via differences measured at 77°F. Isotopic analyses of ten UO_2 blanket fuel rods removed after Seed 1 operation were completed and evaluated. A program for examination of core components removed during Seed 2-Seed 3 refueling was formulated. Measurements made at the Expended Core Facility on Seed 1 clusters indicated growths in the length direction of up to $^1/_{10}$ in. Tests were initiated to determine the residual stresses in the cladding of irradiated fuel plates and to evaluate the effect of clad yielding on effective plate stiffness. Input information was prepared for a new study of the rod withdrawal accident which uses an axially sectionalized core model and accounts for the effects of temperature variation on all parameters. It was determined that postulated buckling of fuel plates in the depleted Seed 2 assemblies to be irradiated in blanket region IV during Seed 3 operation will not affect the thermal limits of the core. Preliminary evaluation was made of the effect of as-built Seed 3 dimensions on core power capability. Measured seed power fractions are reported through 7218 EFPH of Seed 2 operation. Calculations were made to establish earliest allowable shipment times of spent seed and blanket fuel assemblies after the end of Seed 2 operation. During a series of power startups in June, it was reconfirmed that blanket assemblies J-5 and K-8 contain at least one failed blanket rod each. The remaining blanket assemblies did not exhibit any peaking of the delayed neutron activity which indicates that PWR Core 1 contains two failed blanket assemblies at this time. (auth)

25654 (WAPD-PWR-TE-107) CALIBRATION OF CORE FLOW INSTRUMENTATION. TEST EVALUATION OF DLCS-3380101, PERFORMED MARCH 25 TO APRIL 8, 1960. James G. Evans (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 1961. Contract AT-11-1-GEN-14. 8p.

Attached to this report is a letter (WAPD-PWR-S(A)-501 containing pertinent data from R. F. Stratton, dated May 24, 1961. 2p.

The calibration of the seed and blanket recorders was checked and adjusted. After venting, using a calibration board, the cells were zeroed and freeze plugs were formed. The evaluation indicated that if hysteresis is ignored, the goal of a ±1% accuracy in the 60 to 100% scale range was, in general, achieved. Recommendations are given for the future calibration of core flow D/P cells. (B.O.G.)

25655 (WCAP-4056) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., CVTR PROJECT MONTHLY PROGRESS REPORT, JUNE 1961. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Contract AT(30-1)-2289. 28p.

Fuel enrichment specifications are given for the outer zone of the core. Development and testing of transition joint and pressure tube assemblies are outlined. The results of studies of coolant mixing in a fuel assembly are given. The irradiation program status is described. Development of the control system is described, including scram tests of the drive mechanism. Work done on accident analysis is discussed. The results of critical experiments are reported. (D.L.C.)

25656 (YAEC-136) THE NUCLEAR DESIGN OF THE YANKEE CORE. H. W. Graves, Jr., R. F. Janz, and C. G. Poncelet (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Feb. 1961. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. 91p.

The nuclear characteristics of the initial core loading for the Yankee Atomic Electric Company power plant are described. These characteristics include core reactivity, control rod and boron worths, and reactivity coefficients. In addition to operating characteristics, parameters for the cold and hot zero power cores are obtained for comparison with startup experiment data. Calculations to determine these characteristics are based on mechanical design specifications. (auth)

25657 BOILER PLANT FOR TRAWSFYNYDD NUCLEAR POWER STATION. Engineer, 212: 53-5(July 14, 1960).

The fabrication methods and facilities are described for the boiler and other large equipment for the Trawsfynydd nuclear power station. There is also a list of station design particulars. Special emphasis is placed on the transportation of equipment and boiler shell assembly. Descriptions are also given of procedures and equipment used in testing the boiler. (N.W.R.)

25658 LOCOMOTIVES WITH NUCLEAR PROPULSION. Gheorghe Preda and Stefan Dumitrascu. Met. si Constructia de Masini, No. 5, 436-9(1960).

A brief description of a nuclear reactor and the heat transmitting installation is given. Such a reactor can also be used for the propulsion of locomotives by a piston engine and a steam or gas turbine. The last type locomotive seems to be the most advantageous, since it has a high efficiency and does not need a water reserve. A locomotive installation equipped with a homogeneous nuclear reactor, which contains uranium-235 in the form of a uranyl sulfate-heavy water solution, is described. The heat is taken over by common water flowing through 10000 tubes located in the active zone of the reactor. The water is transformed into saturated steam driving a turbine, which is coupled by a reducer to an electric generator. The electric current feeds the electric motors that drive the locomotive. The concrete protection screen weighs 200 tons. The thermal power of the reactor has 30000 kw. The locomotive including the tender, which carries the cooling installation, has a length of 48 m and weighs 327 tons. A steam turbine–nuclear locomotive is also described. The deficiencies of xenon poisoning are excluded by using highly enriched fuels, thus guaranteeing a surplus of reactivity. In case of heterogeneous reactors cooled by closed-circuit gases, a xenon-separating installation can be used. According to calculations, the autonomy of nuclear driven locomotives is approximately 46 times higher than that of coal fueled locomotives. A nuclear driven locomotive can travel 30000 km without being refueled. (OTS)

25659 NUCLEAR ROCKETS FOR TERRESTRIAL AND SPACE MISSIONS. Myron M. Levoy and John J. Newgard (Thiokol Chemical Corp., Denville, N. J.). Planetary Space Sci., 4: 145-58(1961).

Nuclear rockets are applicable to a wide range of missions from boosting a 100,000 lb payload into space with a single-stage vehicle in the million lb thrust class to a Mars probe or Mars orbiting space vehicle with an initial acceleration of 0.3 g and a thrust of 10,000 lb. A prototype nuclear power plant design is discussed briefly, from which either of the above vehicles may be evolved. The problems involved in launching a nuclear vehicle from the ground and the problems of initiation of flight from a 300 mile Earth orbit are discussed. Some features of terrestrial and space flight peculiar to nuclear propelled vehicles are covered. (auth)

25660 AN ANALYSIS OF THE OPTIMUM TEMPERATURE OF HEAT SUPPLY IN STEAM TURBINE CYCLES OF NUCLEAR POWER PLANTS. D. D. Kalafati. Trudy Moskov. Energet. Inst., No. 30, 186-201(1958).

In nuclear power plants with steam turbine installations and an intermediate heat carrier the fuel component of the electric power cost makes up 2.5 to 19%, the expenses of the initial charging of nuclear fuel included. If the latter is excluded, the most economical mean temperature of heat supply in the steam cycle, at which the maximum electric power of the plant can be achieved, is equal to the square root from the product of the maximum admissible temperature of heat yielding elements and the temperature in the turbine condenser. In the presence of regenerative water preheating in the steam cycle a higher temperature, determined by the formula derived, is substituted for the temperature in the condenser. The most economical temperature obtained enables one to cut the number of alternative calculations for commercial planning and designing. The temperatures adopted for some nuclear power plants almost coincide with those obtained by the formula. (OTS)

25661 NUCLEAR PROPULSION. Bibliographical Series Number 3. (International Atomic Energy Agency, Vienna). 1961. 236p. (STI/PUB/21/3)

A bibliography of 1528 references, most with abstracts, is presented on engineering, technological, and economical aspects of nuclear propulsion. (D.L.C.)

25662 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Ronald Parr and John Anthony Wynne Huggill (to A.E.I.-John Thompson Nuclear Energy Co. Ltd.). British Patent 873,612. July 26, 1961.

A heterogeneous reactor is designed for improved heat transfer. In this reactor, fuel elements are arranged in stacks in vertical fuel channels, each element comprising an array of parallel fuel plates mounted on supports and spaced apart to provide coolant passages. The coolant flow is made to follow a zig-zag path through the fuel plates by tilting the fuel stack obliquely across the channel or by means of baffles or recessions in the channel sides. (D.L.C.)

25663 IMPROVEMENTS IN HEAT EXCHANGERS. Norman George Worley (to Babcock & Wilcox Ltd.). British Patent 873,675. July 26, 1961.

A boiler design for gas-cooled reactors is given in which the vapor generating section is arranged to operate with longitudinal coolant flow and the economizer or superheater section with cross coolant flow. This arrangement enables the vapor generating section to be operated by natural cir-

ulation, which results in reduction of power consumed by irculating pumps. (D.L.C.)

5664 IMPROVEMENTS IN COVERS FOR HETEROGENEOUS NUCLEAR REACTORS. (to Allmänna Svenska Elektriska Aktiebolaget). British Patent 873,794. July 26, 961.

A leading-through means in the cover of a heterogeneous eactor is designed so that there are no high thermal tresses due to the different thermal expansion coefficients f carbon steel and stainless steel. The cover is a flat essel comprising a cover plate and a bottom plate with its wer side clad with stainless steel. The leading-through eans comprises an outer tube of carbon steel fixed relave to the cover plate and bottom plate and an inner tube f stainless steel fixed relative to the bottom plate only. .L.C.)

5665 NEUTRONIC REACTOR DESIGN TO REDUCE EUTRON LOSS. F. T. Miles (to U. S. Atomic Energy ommission). U. S. Patent 2,982,709. May 2, 1961.

A nuclear reactor construction is described in which an nmoderated layer of the fissionable material is inserted etween the moderated portion of the reactor core and the ore container steel wall. The wall is surrounded by succssive layers of pure fertile material and moderator conining fertile material. The unmoderated layer of the ssionable material will insure that a greater portion of st neutrons will pass through the steel wall than would ermal neutrons. Since the steel has a smaller capture ross section for the fast neutrons, greater numbers of eutrons will pass into the blanket, thereby increasing the ver-all efficiency of the reactor. (AEC)

5666 MERCHANT MARINE SHIP REACTOR. M. F. nkovich, J. F. Mumm, D. C. North, Jr., H. R. Rock, and . K. Gestson (to U. S. Atomic Energy Commission). U. S. atent 2,982,713. May 2, 1961.

A nuclear reactor for use in a merchant marine ship is escribed. The reactor is of pressurized, light water cooled nd moderated design in which three passes of the water rough the core in successive regions of low, intermediate, nd high heat generation and downflow in a fuel region are ade. The design makes a compact reactor construction ith extended core life. The core has an egg-crate lattice ontaining the fuel elements that are confined between a wer flow baffle and upper grid plate, with the latter servg also as part of a turn-around manifold from which the ntire coolant is distributed into the outer fuel elements for e second pass through the core. The inner fuel elements re cooled in the third pass. (AEC)

5667 APPARATUS FOR SHEATHING RODS. W. K. ord, Mark Wyatt, and Sidney Plail (to U. S. Atomic Energy ommission). U. S. Patent 2,994,423. Aug. 1, 1961.

An arrangement is described for sealing a solid body of uclear fuel, such as a uranium metal rod, into a closelytting thin metallic sheath with an internal atmosphere of ert gas. The sheathing process consists of subjecting the eath, loaded with the nuclear fuel body, to the sequential erations of evacuation, gas-filling, drawing (to entrap int gas and secure close contact between sheath and body), nd sealing. (AEC)

5668 CHIMNEY FOR BOILING WATER REACTOR. ichael Petrick (to U. S. Atomic Energy Commission). S. Patent 2,994,657. Aug. 1, 1961.

A boiling-water reactor is described which has vertical el-containing channels for forming steam from water. isers above the channels increase the head of water dially outward, whereby water is moved upward through the channels with greater force. The risers are concentric and the radial width of the space between them is somewhat small. There is a relatively low rate of flow of water up through the radially outer fuel-containing channels, with which the space between the risers is in communication. (AEC)

Research Reactors

25669 (AERE-R-3549) THE BEPO T.E. HOLE ISOTOPE LOAD/UNLOAD FLASK. E. Emmerton (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). May 1961. 24p.

Detailed operating instructions are included for the load/unload flask. (auth)

25670 (ANL-6350) DESIGN AND DEVELOPMENT REPORT ON TREAT CONTROL ROD DRIVE II. R. V. Batch (Argonne National Lab., Ill.). May 1961. Contract W-31-109-eng-38. 35p.

A discussion is given of the development of TREAT control rod drive II, which describes the basic design, the problems involved with the design, the various design methods pursued, the testing procedures, and the evaluation of the performance characteristics of the final drive. (B.O.G.)

25671 (CEA-1887) SUR UN PHENOMENE DE RENVERSEMENT DU COURANT DE REFRIGERATION DANS LES CANAUX CHAUDS D'UNE PILE PISCINE REFROIDIE EN CONVECTION FORCEE. (On the Phenomenon of the Reversal of the Cooling Current in the Hot Pipes of a Swimming-Pool Type Pile Cooled by Forced Convection). J. Boure (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Grenoble). 1961. 38p.

It is shown, for a swimming-pool type pile cooled by forced convection, general flow downwards, that a permanently stable regime with downward flow in all the channels is not possible when the flow is below a critical value for a given power. In the hot channels the natural convection then becomes preponderant, the direction of the flow is reversed and a permanently stable regime exists for which the flow is upwards in the hot channels. Calculations are made, with simplifying hypotheses, in the case of Mélusine. (auth)

25672 (IEA-18) SOME RESULTS OF THE OPERATION OF THE BRAZILIAN SWIMMING POOL REACTOR IEAR-1. P. S. de Toledo, A. C. Penteado, and H. R. Franzen (Brazil. Instituto de Energia Atomica, Sao Paulo). 1960. 24p.

Presented at the Third Inter-American Symposium on the Peaceful Application of Nuclear Energy, Petropolis, Brazil, July 16-23, 1960.

Results are presented of pre-critical, critical, and power experiments which were performed on the IEAR-1 reactor in the period Jan. 1959 to April 1960. Tests of defective fuel elements and calibration of safety rods and power-measuring instruments are described. High-power operation from 500 kw to 5 Mw is treated. (D.L.C.)

25673 (JEN-86-DQ/I-23) SISTEMA DE PURIFICACION DEL AGUA DE LLENADO DE LA PISCINA DEL REACTOR JEN-1. (Water Deionizing Feed System for the Swimming-Pool of the JEN-1 Reactor). M. Urgell, J. A. Perez Bustamante, T. Batuecas Rodrigues, F. De La Cruz Castillo, and R. Fernandez Cellini (Spain. Junta de Energia Nuclear, Madrid). 1961. 20p.

The purifying water installation for the swimming-pool Reactor JEN-1 of the Nuclear Energy Center "Juan Vigón"

is described. The installation is composed of a sterilizer-clarifier-filterer unit for processing the raw water and two ion-exchange units, one formed by two separated cation and anion resin beds and another by a mixed bed. The results of first operation cycles are given. (auth)

25674 (TID-7608) PROCEEDINGS OF THE UNIVERSITY REACTOR CONFERENCE, HELD AT GATLINBURG, TENNESSEE, AUGUST 17-19, 1960. (Oak Ridge National Lab., Tenn.; Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.; and American Nuclear Society, Oak Ridge, Tenn.). 199p.

Nineteen papers presented at the University Reactor Conference are given. Separate abstracts were prepared for each paper. (M.C.G.)

25675 (TID-7608(p.5-17)) PRESENT USE OF OUR UNIVERSITY REACTOR FOR EDUCATION TRAINING (I). Arthur C. Menius, Jr. (North Carolina State Coll., Raleigh).

The original reactor (NCSCR-1) which was deactivated in 1955 after a corrosion leak, the interim reactor (NCSCR-2) which was operated in the same location as the original until construction began on the heterogeneous reactor after which it was relocated (as NCSCR-4), and the heterogeneous reactor (NCSCR-3) are described. For teaching and laboratories there were 122 operations, compared with 269 for calibration and maintenance, 119 for sponsored research, 431 for unsponsored research, and 58 for short-course programs or institutes. The reactor laboratory experiments performed routinely in courses offered by the college are listed. (M.C.G.)

25676 (TID-7608(p.18-26)) PRESENT USE OF OUR UNIVERSITY REACTOR FOR EDUCATION AND TRAINING (II). Robert E. Uhrig (Florida. Univ., Gainesville).

The University of Florida Training Reactor went critical on May 23, 1959, and was used for routine laboratory operation during the 1959 and 1960 academic year. The experiments performed in the laboratory courses and in graduate and staff research are described. A considerable amount of time was spent in determining the operating characteristics of the reactor. As a result, several modifications of the instrumentation, shielding, and operating procedures were or soon will be incorporated. (M.C.G.)

25677 (TID-7608(p.27-34)) PRESENT USE OF OUR UNIVERSITY REACTOR FOR EDUCATION AND TRAINING (III). Leslie C. Wilbur (Worcester Polytechnic Inst., Mass.).

The Worcester Polytechnic Institute Reactor, which went critical on December 18, 1959, is described. A limited student training program and a staff operation-license program were carried out. Typical experiments are described. (M.C.G.)

25678 (TID-7608(p.35-42)) PRESENT USE OF OUR UNIVERSITY REACTOR FOR RESEARCH (I). William Kerr and C. W. Ricker (Michigan. Univ., Ann Arbor).

The Ford Nuclear Reactor and the Phoenix Laboratory, operated under the direction of the Michigan Memorial Phoenix Project, are described. The use of the reactor in teaching chemistry, chemical engineering, nuclear engineering, and physics; for student and faculty research; for associated work in radiation effects; and for industrially sponsored activities is described. (M.C.G.)

25679 (TID-7608(p.43-50)) PRESENT USE OF OUR UNIVERSITY REACTOR FOR RESEARCH (II). Forrest J. Remick (Pennsylvania State Univ., University Park).

The Penn State Reactor and its facility are described. The operating philosophy, staff and budget, plans for future expansion, waste disposal, educational utilization, operation and experience, and current research are discussed. (M.C.G.)

25680 (TID-7608(p.60-78)) PRESENT USE OF OUR UNIVERSITY REACTOR FOR RESEARCH (III). Theos J. Thompson (Massachusetts Inst. of Tech., Cambridge).

The general development of reactor work at Massachusetts Institute of Technology is outlined. The MIT Reactor is described and a sketch of the program for its use is presented. Equipment for use with the reactor including a facility for studying uranium lattices, gamma spectrographs, neutron diffraction spectrometers, neutron choppers, and a medical therapy facility are described. (M.C.G.)

25681 (TID-7608(p.79-83)) PRESENT USE OF OUR UNIVERSITY REACTOR FOR RESEARCH (IV). Thomas W. Leland, Jr. (Rice Univ., Houston, Tex.).

A description of the Rice University Reactor is presented. The uses of this essentially zero-power reactor in studies of neutron activation, energy levels and decay schemes of complex nuclei, neutron counting techniques, and radiation effects of catalysts are discussed. (M.C.G.)

25682 (TID-7608(p.84-90)) UNIVERSITY REACTORS IN WESTERN EUROPE. Jean Debiesse (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay).

The development of nuclear reactors in the universities of western Europe is discussed. The problems of the reactor program in France are used as an example. The Melusine Reactor at the University of Grenoble is described. The reactors built at French universities are such that they can only be used for teaching purposes and for the production of short-lived isotopes. It was found to be in countries that had no powerful atomic centers that the universities made the biggest effort to possess reactors. In general, the reactors were built by English or American firms. The university reactors include 7 research reactors and 13 educational reactors. Among the reactors under construction or at the advanced planning stage, the Argonaut type appeared to be the most popular. (M.C.G.)

25683 (TID-7608(p.91-7)) SAFETY ASPECTS OF UNIVERSITY REACTORS. Clifford K. Beck (Atomic Energy Commission, Washington, D. C.).

Safety aspects of university reactors are discussed. The difficulties of the university reactor program which have a bearing on safety include finances, insufficient staff, reactor staff members with divided responsibilities, poor maintenance of the reactor facility, insufficient supporting services, organizational incompatibility, and rapid turnover of personnel. (M.C.G.)

25684 (TID-7608(p.98-111)) DETERMINING NEEDS FOR A NUCLEAR REACTOR (I). Andrew Robeson (Virginia Polytechnic Inst., Blacksburg).

The determination of a university's needs for a nuclear reactor is discussed. The Virginia Polytechnic Institute Reactor is described. A graphite–natural uranium subcritical assembly, a water–natural uranium subcritical assembly, and a reactor simulator used before the reactor was constructed are also described and compared to the reactor. Pulse-neutron sources and gamma sources and their uses are discussed. Facts to be considered in deciding whether to obtain a reactor for a school are reviewed. (M.C.G.)

25685 (TID-7608(p.112-15)) DETERMINING NEEDS FOR A NUCLEAR REACTOR (II). Herbert S. Isbin (Minnesota. Univ., Minneapolis).

Nuclear engineering activities at the University of Min-

nesota are described. Funds received from the AEC Division of Reactor Development for teaching aids in nuclear engineering were used to expand several undergraduate laboratory courses and to develop graduate facilities in chemistry, physics, metallurgy, and engineering. Course fragmentation and graduate laboratories are discussed. It was decided that a teaching and demonstration reactor is not a necessity for a nuclear engineering program. (M.C.G.)

25686 (TID-7608(p.116-29)) A REVIEW OF CHARACTERISTICS OF UNIVERSITY REACTORS. J. R. Dietrich (General Nuclear Engineering Corp., Dunedin, Fla.).

The way in which various types of university reactors measure up to the criteria normally applied to scientific apparatus is discussed. The criteria considered were capacity, convenience, precision, and range. Design features that have important effects were emphasized. Hydrogen-moderated and deuterium-moderated research reactors and pool and Argonaut type training reactors were compared. (M.C.G.)

25687 (TID-7608(p.130-4)) PROCURING A UNIVERSITY REACTOR. Glenn Murphy (Ames Lab., Ames, Iowa).

The steps involved in procuring a university reactor are discussed. Topics covered include establishment of specifications for the reactor, preparation of the hazards report, requests for construction and operating licenses, arrangements for insurance, authorization and licensing of special nuclear materials, operator training and licensing, establishment of good public relations with the community, development of procedures for maintaining health and safety in the event of an incident, and provision for the maintenance of records, forms, and reports. (M.C.G.)

25688 (TID-7608(p.135-45)) BUILDING A UNIVERSITY REACTOR. Lawrence R. Quarles (Virginia. Univ., Charlottesville).

The University of Virginia Research and Training Reactor is described. A general description of the facility, the methods of financing, some of the problems encountered, and a detailed breakdown of costs are included. (M.C.G.)

25689 (TID-7608(p.146-51)) OPERATING A UNIVERSITY REACTOR. George Leppert (Stanford Univ., Calif.).

The Stanford University Pool Reactor is described. Experiments by nuclear engineering students using the reactor during 1959 and 1960 are outlined. The utilization of the reactor for thesis research is discussed. The relationship of the nuclear engineering laboratory, including the reactor, to the university administration is described. Reactor management and operation, operating costs, and future usage of the reactor are discussed. (M.C.G.)

25690 (TID-7608(p.152-5)) AEC PROGRAM OF UNIVERSITY RESEARCH-REACTOR SUPPORT. John C. Cera (Atomic Energy Commission, Washington, D. C.).

The AEC programs for assisting educational institutions to establish operating reactors are discussed. It was decided that the AEC will not give any more grants for the acquisition of teaching reactors. However, it will continue to lend source and special nuclear materials without charge to institutions for teaching reactors. General problem areas of concern to the AEC in administering its equipment grant and material loan programs are outlined. (M.C.G.)

25691 (TID-7608(p.156-64)) NSF PROGRAM OF UNIVERSITY RESEARCH-REACTOR SUPPORT. F. Philips Pike (National Science Foundation, Washington, D. C.).

The National Science Foundation program of university research reactor support is summarized. The grants given in the years from 1957 through 1960 are outlined. It was decided to interrupt temporarily the support program and to study the problems of these emerging college reactors. The problems considered include capital costs, reactor capabilities, cost in time, operating costs, research reactor support, reactor licensing, and staff. (M.C.G.)

25692 (TID-7608(p.165-76)) THE FUTURE ROLE OF UNIVERSITY REACTORS. Thomas E. Cole (Oak Ridge National Lab., Tenn.).

A panel discussion on "The Future Role of University Reactors" is presented. The establishment of post-university institutes, the expanding nuclear engineering programs, whether a nuclear reactor is necessary on campus, whether a university reactor should be primarily for research or for training, and the development of major research programs are discussed. (M.C.G.)

25693 (TID-7608(p.177-84)) AVAILABILITY OF UNIVERSITY REACTORS FROM INDUSTRY. Merlin D. Peterson (Argonne National Lab., Ill.).

A panel discussion on "The Availability of University Reactors from Industry" is presented. The question of cost vs. flux, the future possibilities of leasing reactors rather than outright purchase, the high operation and maintenance costs, the construction of training reactors, guidance and aid to universities that may not have experienced personnel, and reasons for having a reactor at a university are discussed. (M.C.G.)

25694 RABBIT TUBE IRRADIATION PLANT AT THE MUNICH RESEARCH REACTOR. Willy Marth. Kerntechnik, 3: 252-7(June 1961). (In German)

A rabbit tube plant is described with the aid of which irradiations can be performed at the Munich research reactor. The radiation dosage can be varied from 10^{12} to 10^{17} n/cm^2. The rabbit tube capsules have an interior diameter of 29.5 mm and a length of 121 mm. Holes are drilled into them so that the samples inside the capsules can be cooled by an air current during irradiation. (auth)

25695 BELGIUM'S NOVEL RESEARCH REACTOR–BR-2. Nuclear Eng., 6: 276-80(July 1961).

Research and design aspects of the Belgian BR-2 research reactor are outlined. The reactor is light water and Be moderated, light water cooled and reflected, and uses 90% enriched U fuel. It contains beam holes, internal irradiation facilities, and pool irradiation facilities with available fast and thermal neutron fluxes on the order of $10^{14}/cm^2/sec$. Proposed uses of the reactor are outlined. (T.F.H.)

WASTE DISPOSAL AND PROCESSING

25696 (IDO-14548) PNEUMATIC ATOMIZING NOZZLES IN FLUIDIZED BED CALCINING. I. CALIBRATION TESTS. B. M. Legler and J. I. Stevens (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). May 12, 1961. Contract AT(10-1)-205. 29p.

The results of test stand studies of a pneumatic atomizing nozzle to be used in the Demonstrational Waste Calcining Facility at the Idaho Chemical Processing Plant are presented. Atomization and performance characteristics are described. The liquid feed control system for the Demonstrational Waste Calciner is compared with results of bench scale tests, and recommendations are made for improving the system. (auth)

25697 (LAMS-2566) LOW EXPOSURE METHOD FOR DISPOSING OF HIGH ACTIVITY WASTES. J. W. Schulte, F. J. Fitzgibbon, and D. S. Shaffer (Los Alamos Scientific Lab., N. Mex.). June 15, 1961. Contract W-7405-eng-36. 12p.

A method for disposing of process wastes containing from 0 to 500 curies of beta-gamma materials is described. The entire process, from encapsulating in a hot cell through burying in the ground, results in only nominal radiation exposure to operating personnel. Possible application of the technique in the disposition of other waste materials is discussed. (auth)

25698 (NYO-7834) STUDIES OF RUTHENIUM AND CESIUM RETENTION ON SOIL-SAWDUST AND SOIL-PEAT MIXTURES. George T. Bryant, John T. O'Connor, and Irmgard Wintner (Johns Hopkins Univ., Baltimore). June 1961. Contract AT(30-1)-1477. 45p.

Investigations were made to determine whether ruthenium or cesium would be retained in increasing amounts from sodium nitrate solution when the solution was stored in contact with soil and fermentable materials such as sawdust and peat. Using sodium nitrate solutions ranging from 0.5 to 2.0 M and storage periods up to 120 days, the following general results were obtained: the retention of ruthenium on soil-sawdust mixtures increases with storage period for sodium nitrate concentrations up to 2.0 M; some increase in retention of ruthenium on soil-peat mixtures occurred, but the increases were not very pronounced; and there was no appreciable increase in retention with time of cesium on soil-sawdust mixtures; there was no increase in retention with time of cesium on soil-peat mixtures. The peat, however, showed a greater capacity for retaining cesium than the sawdust did. (auth)

25699 (TID-7613) REPORT OF THE SECOND WORKING MEETING ON FIXATION OF RADIOACTIVITY IN STABLE, SOLID MEDIA, [HELD] AT IDAHO FALLS, IDAHO, SEPTEMBER 27-29, 1960. James M. Morgan, Jr., Donald K. Jamison, and John D. Stevenson, comps. and eds. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho and Division of Reactor Development, AEC). Feb. 1961. Contract AT(30-1)1477. 782p.

Separate abstracts have been prepared for the 36 papers included. Abstracts not appearing in this category appear under Chemistry — Radiation Chemistry and Radiochemistry. (C.H.)

25700 (TID-7613(p.6-26)) PRELIMINARY STUDIES ON FLUID-BED CALCINATION OF PUREX PROCESS WASTES. A. A. Jonke, J. W. Loeding, and L. J. Anastasia.

Purex waste proved to be susceptible to fluidized bed calcination. Better operational results were obtained with low acid waste primarily because of the early de-emphasis of high acid waste studies. Operations with both low acid waste and low acid waste with added sucrose tended toward product particle growth, which may be controlled by the use of an attrition air jet. Fission product distribution data are based upon only two runs with dissimilar feeds. Results indicate that sucrose addition to the feed results in containment of the ruthenium in the calcine; without sucrose it appears that ruthenium will be volatilized to a large extent. Additional work to expand these exploratory studies is underway at Hanford. (auth)

25701 (TID-7613(p.27-45)) RADIANT HEAT SPRAY CALCINATION. B. M. Johnson, Jr.

Preliminary results show that spray calcination has several characteristics which make it attractive for waste calcination. The operation is insensitive to changes in waste composition and is readily adaptable to many different type of feed. Remote operation and maintenance should be relatively simple in comparison to other proposed methods of calcination. (auth)

25702 (TID-7613(p.46-61)) FLUIDIZED BED CALCINING AT THE IDAHO CHEMICAL PROCESSING PLANT. J. I. Stevens.

The process flowsheet chosen is reviewed. The 4-ft diameter calciner is heated by circulating liquid NaK, heated in an oil-fired furnace, through bayonet-type tubes submerged in the fluidized bed. The calciner is capable of operating at 500°C with NaK temperatures as high as 760°C. Results are reported for test. (C.H.)

25703 (TID-7613(p.62-110)) SOME RECENT DEVELOPMENTS IN FLUID-BED CALCINATION EQUIPMENT. A. A. Jonke.

During the 7-yr period since the first fluid-bed calciner was developed at Argonne, a number of changes and improvements have been made. Improvements in particle size control, filtration of calciner off-gases, and heating are described. (auth)

25704 (TID-7613(p.111-32)) LABORATORY-SCALE BATCH CALCINATION STUDIES INTERIM REPORT. A. M. Platt and J. J. Shefcik.

Laboratory scale studies on the batch calcination of simulated, high-level Purex wastes are described. It is pointed out that the possible chemical composition of the high-level Purex wastes entering the calcination facility can cover a broad range. Data are tabulated on results using wastes of various compositions. Three basic operational techniques were investigated using pots fabricated from 5 or 7-in. length of 3-in. stainless steel pipe. Studies were made on operational techniques and the effect of waste composition on the characteristics of the deposited solids. No radioactive constituents or stand-ins were used. Run conditions and results are tabulated. (C.H.)

25705 (TID-7613(p.133-56)) CONVERSION OF WASTE TO POT CALCINATION. J. O. Blomeke.

The pot calcination process for converting high-activity waste to solids for permanent disposal consists of evaporation to dryness and calcination at 900°C in a portable stainless steel pot, which can be used as the final storage container. Off-gases are processed by condensation, absorption, and fractionation. Calcination rates corresponding to 20 liters of concentrated waste per hour were dem-

onstrated in 6- and 8-in.-dia by 78-in.-high stainless steel pots with a total noncondensable off-gas production of less than 200 liters per hr. The process is simple and versatile enough to handle the variety of wastes produced by a multipurpose power reactor fuel processing plant. (auth)

25706 (TID-7613(p.157-79)) CERAMIC SPONGES FOR RADIOACTIVE WASTE DISPOSAL. George D. Kelly.

Promising results were obtained from laboratory studies on the disposal of radioactive wastes by sorption in ceramic sponges and fixation by firing. Desired sponge characteristics are discussed, and experimental work is reviewed on sponge production, sintering temperature studies, burnout of materials, and selection of sponge geometry and size. (C.H.)

25707 (TID-7613(p.180-201)) ROTARY KILN CALCINATION OF HIGH LEVEL WASTES AS A FIRST STEP IN ULTIMATE DISPOSAL. R. F. Domish, W. R. Regan, and L. P. Hatch.

Results are reported from rotary kiln calcination experiments on simulated aluminum nitrate and zirconium fluoride wastes. The principal problem in the development of the rotary kiln for waste calcination centered on the two rotary seals. The seals must not only be capable of preventing the escape of any gases and entrained dust to the outside atmosphere, but they must have sufficiently long life with trouble-free operation so that maintenance and replacement will not be excessive. The most important operations problems beyond the thermal decomposition itself are those associated with the control of the radioactive dust. With good heat transfer and continuous operation, it was demonstrated that a high degree of dust control is obtained during the calcination of aluminum nitrate feed in a 6-in. diameter rotary kiln by direct condensation of the off-gases. Problems encountered in the continuous calcination of zirconium fluoride wastes were investigated with bench-scale continuous equipment. Matters of concern during this study were quality and mobility of product, over-all corrosion of equipment together with detailed corrosion studies on a number of materials, and tendency for cake formation. Pilot plant equipment are described and illustrated photographically and results of test runs are reported. (C.H.)

25708 (TID-7613(p.202-19)) FIXATION OF FISSION PRODUCTS IN GLASS. L. C. Watson.

The process for incorporating fission products into glass was developed to the stage where design, construction, and operation of a pilot plant were considered. The product of the process has the majority of the attributes required of a solid for fission product disposal. These include insolubility, durability, reasonable manufacturing methods, and relatively simple storage requirements. (auth)

25709 (TID-7613(p.220-50)) THE DISPOSAL OF FISSION PRODUCT WASTES BY INCORPORATION INTO GLASS. M. N. Elliot, J. R. Grover, W. H. Hardwick, and K. D. B. Johnson.

A method was developed for converting highly radioactive fission product wastes into solids for long-term storage. The process starts with a flash evaporation and finally produces a non-leachable glass in disposable vessels. The process is adapted to produce a glass of controlled composition with minimum addition of inactive materials. This gives a volume reduction and an inert and insoluble product. Results are reported from chemical studies of glass compositions and properties, studies of Ru and Co behavior on a bench scale, the evaporation of wastes dosed with millicurie activities of Ru on a scale less than that of the process, and the study of full volumetric scale equipment, both inactive and with millicurie levels of activity. (C.H.)

25710 (TID-7613(p.251-69)) FIXATION OF LOW AND INTERMEDIATE ACTIVE CONCENTRATES BY INCLUSION IN LOW MELTING INERT MEDIA. P. Dejonghe and N. Van de Voorde.

The active concentrate, produced during the treatment of low and intermediate activity effluents, represents about 1% of the original volume. A survey was made on the feasibility of insolubilizing these effluents by inclusion in tar or similar products. Different types of tar and mixing conditions were tested and the effects of radiation on the mechanical and chemical stability of the mixtures were investigated. Results are reported for two different types of tar. (C.H.)

25711 (TID-7613(p.270-9)) DESCRIPTION OF A PILOT PLANT DESIGNED FOR VITRIFICATION OF FISSION PRODUCT SOLUTIONS. Pierre Cohen.

Design features are described and illustrated of a pilot plant built to determine the feasibility of making an insoluble glass from residual radioactive waste solutions by a continuous process. The unit operated continuously for periods of 100 hr using a synthetic solution. (C.H.)

25712 (TID-7613(p.280-99)) APPARATUS FOR CARRYING OUT VITRIFICATION IN A HOT CELL. Roger Bonniaud.

The design of a unit for vitrifying radioactive products is described. The apparatus was designed to verify results of pilot plant studies on the leaching of higher activity wastes from glass pellets and the volatilization of fission products during the melting of glass. Equipment contamination and remote-control apparatus, and glass melting techniques were also studied. A flow sheet of the process is included. (C.H.)

25713 (TID-7613(p.300-9)) CALCINATION OF ZIRCONIUM FLUORIDE WASTE AND ION EXCHANGE SEPARATION OF CESIUM FROM PROCESS WASTES USING AMMONIUM PHOSPHOMOLYBDATE. R. L. Hickok.

A study was made of problems involved in the treatment and disposal of fluoride-containing wastes. The principal problems attendant to treatment or storage of this waste result from the corrosiveness of the mixed nitric-hydrofluoric acid solution or to the extreme toxicity of hydrofluoric acid. The approach investigated included neutralization with calcium oxide followed by calcination of the resulting slurry to fix the fluorine. Results are also reported from a study of fission product removal from solutions simulating process wastes by means of ion exchange. Preliminary studies on Cs removal on ammonium phosphomolybdate showed considerable promise. (C.H.)

25714 (TID-7613(p.310-38)) STUDIES ON ION EXCHANGE AND GLASS FORMATION AS APPLIED TO ULTIMATE WASTE DISPOSAL. E. J. Tuthill, G. G. Weth, and A. Abriss.

The separation of Cs and Sr from waste solutions would remove two of the most hazardous materials and would virtually eliminate the problem of heat generation in the waste after a period of some 7 yr. Results are reported from studies on ion exchange removal of Cs and Sr from waste solutions and subsequent fixation in glass. A number of phosphate glasses were made with various concentrations of representative waste products. Results are included from preliminary studies on leaching. (C.H.)

25715 (TID-7613(p.339-59)) OFF-GAS PROBLEMS IN POT CALCINATION. J. T. Roberts.

Pot calcination of high-level waste concentrates offers more formidable off-gas problems than normally encountered in the evaporation of first-cycle solvent-extraction

raffinates which produces the concentrates. After condensation and NO_2 absorption, however, the off-gas volume is very small and treatment problems are thereby minimized. By comparison with evaporation, pot calcination is subject to more entrainment and more volatilization of both radioactive and non-radioactive constituents. The greater entrainment can result from more vigorous boiling and frothing, including boiling down through a viscous region to dryness, and from higher linear velocities in off-gas lines. The greater volatility can result from more drastic chemical conditions, including higher acidity, higher nitrate concentrations and higher temperatures. Experience with pot calcination of a synthetic Purex waste concentrate is described. Studies were made on physical entrainment, Ru volatility, sulfate volatility, Cs and nitrate volatility, nitrate volatility, and the effect of NO on off-gas production. (C.H.)

25716 (TID-7613(p.360-9)) CLEANUP OF GAS STREAMS FROM FLUID BED CALCINER. B. R. Wheeler.

The off-gas treatment system in the Demonstrational Waste Calciner Facility was designed to provide over-all decontamination factors of 10^4 for dust and 10^3 for ruthenium. The facility presents problems in gas cleanup and dust removal far more troublesome than any previously faced. All laboratory and pilot plant data indicate that the plant as designed should accomplish the necessary decontamination of the off-gas. (auth)

25717 (TID-7613(p.370-95)) ROTARY KLIN CALCINER OFF-GAS TREATMENT. W. H. Regan.

Problems of off-gas cleaning during the operation of a rotary kiln calciner are discussed. Tests with rotary kilns showed that non-condensables are about equivalent to the volume of the initial feed. A unit was designed and tested which has rotary seals that are not blanketed with steam and allow the admission of air. When liquid is calcined at the rate of about a gallon on hour only about two cu ft/hr of non-condensable off-gases are produced. A process flow diagram and photographs of this plant are included. Operational tests of the unit led to the conclusion that by eliminating the introduction of non-condensables into the calcination process, and thereby making possible total condensation of the off-gases, complete control of the dust in the system can be achieved. This procedure does not necessarily create a liquid waste disposal problem since the condensate can be decontaminated to a high degree by a single stage of evaporation. (C.H.)

25718 (TID-7613(p.396-401)) PARTICULATE ATTENUATION IN A PACKED DISTILLATION TOWER. J. J. Perona.

A series of experiments was made to evaluate the effectiveness of the distillation tower in a pot calcination plant flowsheet as a scrubber for soluble aerosols. An air stream containing $Cr(NO_3)_3$ aerosol, with Cr^{51} tracer, was passed through a tower packed with 0.25-in. Raschig rings and operating at total reflux. The $Cr(NO_3)_3$ aerosol, having a lower vapor pressure than the partial pressure of the steam in the vapor phase, would be expected to grow in size by diffusion of H_2O into the droplets. Sufficient growth of the aerosol resulted in attenuation by the liquid phase in the tower due to inertial effects as the air stream passed through the passages of the packing. The phenomenon was demonstrated by passing the aerosol stream through millipore filters before and after passage through the tower and counting the Cr^{51} tracer. Size distributions were obtained before and after passing through a wetted tower wall by collecting droplets on microscope slides with a cascade impactor and measuring with a microscope. Data are presented graphically. (C.H.)

25719 (TID-7613(p.402-16)) CORROSION PROBLEMS IN POT CALCINATION OF HIGH-LEVEL RADIOACTIVE WASTES. W. E. Clark.

Corrosion of duplicate specimens of stainless steel during calcination of synthetic Hanford Purex waste was 6.7 mils/month. This corresponds to a maximum penetration in a 24-hr cycle of 0.26 mil. Maximum rates during evaporation were 0.63 and 1.33 mils/month for a low-carbon nickel alloy and for Hastelloy F, respectively, with both alloys showing grain boundary attack. Both these alloys showed aggressive grain boundary attack in calciner condenser-absorber solutions of 6–15 M nitric acid and 0.05–1.0 M sulfuric acid. Addition of excess Na^+, Mg^{2+}, and/or Ca^{2+} to the waste before calcination will decrease the volatilized sulfate and should decrease the corrosiveness of the condensate. Darex-Purex and Darex-Thorex waste solutions attacked types 304 L and 347 stainless steel by a grain-boundary mechanism in tank storage tests carried out at temperatures of 50, 65, and 80°C. Onset of the attack was delayed 5–20% by lowering the acid concentration from 5 to 2 M, and considerably further delayed by decreasing the temperature from 80 to 50°C. The effect of radiation on corrosion has not been determined. The material for construction of the pot appears to offer no problem. The stainless steels tested are not entirely satisfactory for tank construction without further measures such as anodic protection or the use of inhibitors or cooling to lower temperatures. One or a combination of these measures should prove feasible. Neither the low-carbon nickel alloy tested nor Hastelloy F is satisfactory for the evaporator of the condenser-absorber because of grain boundary attack. (auth)

25720 (TID-7613(p.417-28)) CORROSIVENESS OF SIMULATED PUREX WASTES. R. P. Omberg and E. R. Irish.

The corrosion rates of various forms of the Purex process waste (1WW) were measured with simulated wastes for several materials of construction. Data were obtained for liquid-sludge storage under cooled and boiling conditions to aid in evaluating alternative schemes for interim storage of liquid-sludge wastes prior to calcination. Rates were also determined for corrosion of metals by calcined wastes formed by different calcination techniques and over a range of temperatures. A summary is presented of the major corrosion rate data available to date and specifically pertinent to Purex process waste storage. (C.H.)

25721 (TID-7613(p.429-46)) MATERIALS OF CONSTRUCTION AT THE IDAHO CHEMICAL PROCESSING PLANT. N. D. Stolica.

Data are presented from studies on corrosion in equipment used for the calcination of aluminum nitrate waste solutions and in the storage containers for the aluminum oxide calcined product. Three calciners were studied: a three-inch laboratory model, a six-inch engineering model, and a twenty-four-inch prototype. Corrosion of metals considered for the construction of calcined waste storage facilities was studied in environments of air, calcined alumina, and sand, but in the absence of fission products. Two laboratory models of a storage system were built and studied. Schematic sketches are included. (C.H.)

25722 (TID-7613(p.447-60)) STUDY OF CORROSION IN THE CALCINING OF RADIOACTIVE WASTE SOLUTIONS CONTAINING FLUORIDES AND NITRATES. Roy Domish.

A study was made of the calcination of synthetic STR waste solution containing about 0.5 molar zirconium fluoride and 0.75 molar aluminum nitrate. A two-kiln system was used in which the first kiln was operated at about 325°C

for the purpose of decomposing the nitrates, and the second kiln at 700°C to hydrolize the fluorides. Feed solution was metered into the upper kiln of the two-kiln apparatus and powder from the upper kiln passed through a star feeder and screw feeder into the lower kiln which was supplied with adequate superheated steam to react with the zirconium fluoride. Varying the temperature of the first kiln affected the composition of the condensate of the second kiln gases. Temperatures lower than 325°C at the exterior of the first kiln permitted undecomposed nitrate to pass into the second kiln. The condensate of the first kiln gases contained about 2% hydrofluoric acid in nitric acid at an operating temperature of 325°C. A 500 hour corrosion test with specimens of 47 materials in each kiln showed the corrosion to be very slight in the first kiln. In the second kiln the corrosion was severe on many materials. However, four alloys demonstrated very good resistance to attack. These included Inconel X, Haynes 25, Illium G, and Nionel. A 500 hour corrosion test in a single kiln system operated at 700°C again demonstrated good corrosion resistance by the four materials listed above. It was concluded that kiln corrosion in the presence of hydrogen fluoride and oxides of nitrogen is not a severe problem as long as the temperature is high so that, in effect, one has a dry system. (auth)

25723 (TID-7613(p.461-84)) CHARACTERISTICS OF SOME SOLIDS PROPOSED FOR THE FIXATION OF RADIOACTIVITY IN SOLID MEDIA. G. B. Barton.

Data are summarized on the melting point, solubility, volatilization, thermal conductivity, and radiation stability of a number of solids proposed for the fixation of radioactivity in solid media. Emphasis is placed on the fixation of high-level Purex waste. The major constituents of the waste are tabulated, and the range of variation in the relative amounts of Fe, Al, and Na are shown. Data are included on the thermal conductivity of spray calcined powders, melted wastes, the composition of the solutions from which the various salts were made, and the solubility of phosphate glasses. (C.H.)

25724 (TID-7613(p.485-513)) CHARACTERIZATION OF SOLID PRODUCTS OF POT CALCINATION. H. W. Godbee.

A laboratory program in high level waste treatment is described that is aimed at converting liquid wastes to thermally stable dry solids, principally fritted oxides and sulfates, by evaporation and calcination in a stainless steel vessel which will serve as final storage container. The gases and vapors, principally water, nitric acid, nitrogen dioxide, oxygen, and nitrogen, from the calcination vessel pass into a down-draft condenser which liquefies most of the water and nitric acid and, in addition, acts as a wetted-wall scrubber which removes nitrogen oxides and most of the volatile and entrained radioactivity. The oxides of nitrogen and other noncondensables from the condenser pass into an absorber-scrubber. The products from the process are contaminated nitric acid, a small volume of off-gas, and a dry solid, thermally stable to the temperature of calcination. The behavior of synthetic fuel reprocessing waste solutions during batch and semi-continuous evaporation and calcination was studied and the products formed were characterized. Material balances for nitrate, sulfate, and ruthenium were made. The thermal conductivity of the solid products was measured as a function of temperature. Wastes included in this study are TBP-25, acid deficient Thorex, Darex, and Purex. Batch evaporation-calcination experiments to 400 to 500°C were carried out in glass equipment. The residues from these experiments in glass were further calcined in ceramic boats up to 1200°C in a muffle furnace. In addition, semi-continuous experiments to 800 to 900°C were carried out in a stainless steel pot connected to a glass condenser, absorber-scrubber, and a polyethylene bag in series. The polyethylene bag served as an expansion bag or gas holder so that the system could be operated as a closed system without pressure build-up. Thermal conductivity measurements were made employing radial heat flow in a hollow cylinder arrangement of apparatus. The apparatus is illustrated photographically and data are tabulated. (C.H.)

25725 (TID-7613(p.514-34)) FIXATION OF FISSION PRODUCTS IN STABLE SOLID MEDIA AND STORAGE OF CALCINED WASTES AT THE ICPP. D. W. Rhodes.

Based on the limited amount of laboratory data available, separation of the alloy metal and process chemicals from the fission products followed by fixation of the fission products in a metal matrix appears to be a promising approach as an ultimate disposal method. This method will provide for ready dissipation of fission product heat, permit positive control of the stored product, and provide a near minimum volume for storage of the fission products. If the technology is not available to permit an initial separation of the alloy and fission products, gross wastes can be converted to a solid for storage, or further treated for final disposal. The low level or intermediate level wastes can be converted to a solid and stored in low integrity containers. (auth)

25726 (TID-7613(p.535-49)) CALCULATION OF TEMPERATURE RISE IN DEEPLY BURIED RADIOACTIVE CYLINDERS. J. J. Perona and M. E. Whatley.

For calculational purposes the storage model was divided into a cylindrical cavity in an infinite solid medium with a decaying heat flux at the surface, and a solid cylinder with uniform heat generation surrounded by a 1-in. air space responding to the changing cavity surface temperature. Temperatures in the solid cylinder and the surrounding air space at any time were assumed to be the steady-state temperature corresponding to the cavity surface temperature and the heat generation rate at that time. The temperature profile in the infinite solid medium with a decaying heat flux at the surface and at uniform initial temperature was calculated from finite difference equations with a digital computer. Results are presented graphically. Applications to the storage of Purex waste resulting from natural uranium irradiated to 10000 Mwd/t and reduced to 10 gal of solid per ton are discussed. It was concluded that the storage of cylinders of a practical size is feasible without excessive temperature rise. (C.H.)

25727 (TID-7613(p.550-75)) CONTAINMENT AND STORAGE OF CALCINED WASTES. (CONCEPTUAL FACILITIES AND COSTS). B. F. Campbell.

Storage criteria and cost estimates are presented for the containment and storage of calcined wastes. The treatment of Purex wastes at Hanford is used as a basis for analyzing the cost of containing and storing a calcined product. The cost estimates are based on relatively unproven assumptions regarding the appropriateness of the methods and criteria employed. Topics discussed include the overall concept of waste solidification, a conceptual arrangement of a calcination and solids storage area employing water cooling, alternatives for solids containment and storage, cost variations for calcined wastes of various characteristics, and a quantitative comparison of the physical characteristics and the resultant containment and storage costs relating to Purex alternatives. (C.H.)

25728 (TID-7613(p.576-89)) FIXATION IN VITREOUS MATRICES OF HIGH ACTIVITY FISSION PRODUCT

WASTES. Rolf Eliassen and Morton I. Goldman.

Results are summarized from a series of studies on the preparation of glasses from synthetic wastes from the chemical processing of spent reactor fuel elements. Typical wastes from Al, stainless steel, and Zr-clad fuel elements were used. Proposed flow sheets are presented. Data are tabulated on waste composition, glaze composition, preparation of the glass, Cs loss by volatilization, and leaching rates of glasses of various compositions. (C.H.)

25729 (TID-7613(p.590-622)) CERAMIC SPONGES FOR RADIOACTIVE WASTE DISPOSAL. R. G. Thomas, G. D. Kelley, and C. W. Christenson.

Preliminary investigations on the feasibility of permanently fixing radionuclides in ceramic sponges by firing indicated that large amounts of low salt content wastes can be stored in this manner, but results with high salt wastes were poor. The process involves the preparation of a highly porous clay body which is fired to about 1100°C. This body is then soaked in the liquid waste, dried, and resoaked. The cycle is repeated as many as five times, and the clay body is then fired at 1300°C to fix the radionuclide permanently. Tests showed that about two volumes of waste may be incorporated in one volume of ceramic. This method results in little contamination of the air stream. It may also be used for interim storage or shipment of low salt content waste. (C.H.)

25730 (TID-7613(p.623-40)) WASTE FIXATION ON MINERALS. J. F. Honstead, J. L. Nelson, B. W. Mercer, and W. A. Haney.

Reactions involving radionuclides and solid minerals which result in the selective removal of radioisotopes from waste streams were investigated as a means of fixing fission products in a solid without also incorporating the large concentrations of stable chemicals that usually accompany radioisotopes in wastes. Studies were made of both mineral replacement reactions and specific absorption reactions. Results are reported from scouting studies on fission product removal from various types of high-salt, high-activity wastes by passage through clinoptilolite columns. The method gave good results for the removal of Cs^{137}, Sr^{90}, Co^{60}, rare earths, and α emitters. Advantages and disadvantages of this type of waste treatment are discussed. (C.H.)

25731 (TID-7613(p.691-718)) MINERAL REACTIONS PERTINENT TO THE TREATMENT AND DISPOSAL OF RADIOACTIVE WASTES. D. G. Jacobs and T. Tamura.

As radioactive waste solutions pass through the ground, there are continuous reactions between the radionuclides and the stable salts of the waste solution and the minerals of the soil. Knowledge of these reactions is necessary for a complete evaluation of any nuclear waste-disposal scheme. Various mineral reactions of Cs and Sr were investigated by slurry and by column techniques. Results indicate that clay minerals with a mica-like structure are effective for decontamination of Cs from systems containing large amounts of sodium salts. Phosphate mineral systems show much more promise for the removal of Sr than do the clay mineral systems. The effectiveness of these minerals suggests practical application in mineral-filled columns for removal of Cs and Sr from intermediate- and low-level waste streams. The information obtained in the studies has further application in depicting the movement of these radionuclides from ground sites to which radioactive wastes have been released. (auth)

25732 (TID-7613(p.719-27)) RADIOACTIVE WASTE FIXATION—COPRECIPITATION AND FUSION. K. W. Calkins.

The coprecipitation of low-level radioactive materials with glass forming solids, followed by filtration, drying, and fusing to a chemically stable block is discussed as a means of waste fixation. A flow sheet is presented for a process using a lead borosilicate glass. Preliminary cost factors are included. (C.H.)

25733 PROCESSING HIGH RADIOACTIVE WASTE. Jaroslav Saidl (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Prague). Jaderná energie, 7: 181-90(1961). (In Czech)

A summary of information on highly active waste types is given, and their origin and treatment are explained. A survey of research in the field of active waste disposal by the method of fixation in silicates is also given. (tr-auth)

DEPOSITORIES OF USAEC REPORTS

In Countries Other than the U.S.

ARGENTINA
Buenos Aires, Comisión Nacional de Energía Atómica

AUSTRALIA
Canberra, Australian National Library
Sutherland, New South Wales, Australian Atomic Energy Commission

AUSTRIA
Vienna, Zentral Bibliothek der Physikalischen Institute der Universität

BELGIUM
Brussels, Centre d'Etudes pour les Applications de l'Energie Nucléaire

BRAZIL
Rio de Janeiro, Instituto Brasileiro de Bibliografia e Documentacao
São Paulo, Instituto de Energia Atomica, Cidade Universitaria São Paulo

BURMA
Rangoon, Union of Burma Applied Research Institute

CANADA
Hamilton, McMaster University
Ottawa, National Research Council Library
Vancouver, University of British Columbia

CEYLON
Colombo, University of Ceylon

CHILE
Santiago, Instituto de Investigaciones Geologicas

CHINA
Hsinchu, Formosa, National Tsing Hua University Library

COLOMBIA
Bogota, Instituto De Asontos Nucleares

COSTA RICA
San Pedro, University of Costa Rica Library

CUBA
Havana, Comisión de Energía Nuclear de Cuba

DENMARK
Risö, Danish Atomic Energy Commission

DOMINICAN REPUBLIC
Ciudad Trujillo, National Palace

ECUADOR
Quito, Escuela Politécnica Nacional

EGYPT
Cairo, Atomic Energy Commission

EL SALVADOR
San Salvador, Universidad de El Salvador, Biblioteca de Energia Nuclear

ENGLAND
Birmingham, Central Library
Bristol, Central Library
Kingston upon Hull, Central Library
Leeds, Central Library
Liverpool, Central Library
London, Central Library, Acton

ENGLAND (CONT.)
London, Science Museum Library, South Kensington
Manchester, Central Library
Newcastle upon Tyne, Central Library
Nottingham, Public Libraries
Sheffield, Central Library

FINLAND
Helsinki, Teknillisen Korkeakoulun Kirjasto

FRANCE
Gif-sur-Yvette, Centre d'Etudes Nucléaires de Saclay
Paris, Académie des Sciences

GERMANY
Berlin, Hahn-Meitner-Institut für Kernforschung Berlin
Frankfurt/Main, Gmelin-Institut
Munich, Technische Hochschule, Bibliothek

GHANA
Accra, University College of Ghana

GREECE
Athens, Greek Atomic Energy Commission

GUATEMALA
Guatemala, Comisión Nacional de Energía Nuclear

HAITI
Port au Prince, University of Haiti

HONDURAS
Tegucigalpa, Comisión Hondureña de Energía Atómica

ICELAND
Reykjavik, University of Iceland, Atomic Energy Library

INDIA
Bombay, Department of Atomic Energy

INDONESIA
Bandung, Java, Bandung Institute of Technology

IRAN
Tehran, Tehran University Center for Nuclear Studies

IRAQ
Baghdad, Iraqi Atomic Energy Commission

IRELAND
Dublin, University College

ISRAEL
Rehovoth, Israel Atomic Energy Commission

ITALY
Milan, Centro di Studi Nucleari di Ispra del C.N.R.N.
Rome, Comitato Nazionale per le Ricerche Nucleari

JAPAN
Tokyo, Science Section, Diet Library

KOREA
Seoul, Office of Atomic Energy

LEBANON
Beirut, American University

LUXEMBOURG
Luxembourg, Ministry of Transport and Electricity

MEXICO
Mexico, D.F., Comisión Nacional de Energía Nuclear

NETHERLANDS
The Hague, Reactor Centrum Nederland

NEW ZEALAND
Wellington, Department of Scientific and Industrial Research

NORTHERN IRELAND
Belfast, Department of Industrial and Forensic Science

NORWAY
Lillestrom, Institutt för Atomenergi

PAKISTAN
Karachi, Pak. AEC Laboratory

PERU
Lima, Biblioteca Nacional

PHILIPPINE REPUBLIC
Manila, Philippine Atomic Energy Commission

POLAND
Warsaw, Biura Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej

PORTUGAL
Lisbon, Junta de Energía Nuclear

REPUBLIC OF SOUTH AFRICA
Pretoria, Atomic Energy Board Library, Council for Scientific and Industrial Research

REPUBLIC OF THE CONGO
Leopoldville, Université Lovanium

SCOTLAND
Glasgow, Mitchell Library

SPAIN
Madrid, Junta de Energía Nuclear

SWEDEN
Stockholm, Aktiebolaget Atomenergi

SWITZERLAND
Zurich, Institut für Physik, Eidg. Technische Hochschule

THAILAND
Bangkok, Office of the Thai Atomic Energy Commission, Department of Science

TURKEY
Ankara, Turkish Atomic Energy Commission, Atomic Energy Library

URUGUAY
Montevideo, Comision Nacional de Energia Atomica

VENEZUELA
Caracas, Instituto Venezolano de Investigaciones Cientificas

VIET-NAM
Saigon, Office of Atomic Energy

YUGOSLAVIA
Belgrade, Federal Nuclear Energy Commission

In International Agencies

AUSTRIA
Vienna, International Atomic Energy Agency

BELGIUM
Brussels, La Bibliotheque EURATOM

FRANCE
Paris, European Nuclear Energy Agency, O.E.E.C.

ITALY
Ispra, EURATOM Research Center

SWITZERLAND
Geneva, United Nations Library

UNITED STATES
New York, United Nations Headquarters
Washington, D. C., Inter-American Nuclear Energy Commission